Big Moose, July 6, 1903, on hemlock where it was probably about to oviposit.

Associated species. Several other beetles were bred from the hickory trunk infested by this species. Neoclytus erythrocephalus Fabr., was obtained in small numbers, the beetles appearing at the same time as Xylotrechus. A few specimens of Tomoxia bidentata Say, were reared from the more decayed portions of the tree and appeared in early June. The common flat headed borer of the apple, Chrysobothris femorata Fabr., was also bred in small numbers, the beetles emerging from the wood in early June. A cucujid, Catogenus rufus Fabr., was obtained in small numbers the latter part of May and early in June. This species undoubtedly occurred under the dead bark and in no way assisted in the destruction of the tree. A horn tail, probably the pigeon tremex, Tremex columba Linn., was at work in some of the more decayed portions of the trunk, accompanied by its parasite, the lunate long sting, Thalessa lunator Fabr.

Parasites. This species was rather extensively parasitized by the common enemy of many wood borers, Melanobracon simplex Cress., most of which emerged in the month of May. A few specimens of a large Ichneumon, Arotes decorus Say, were bred out in early June.

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Northern brenthian

Eupsalis minuta Drury

A slender grub ¾ inch long and not quite ¹⁄₂₀ inch thick, bores in the solid wood of white oak, changing to a weevil with a rather prolonged, thick snout.

This is one of the most peculiar beetles found in New York State. The female is remarkable not only on account of her slender proportions, but because the beak is prolonged into a long snout which, unlike that of most snout beetles, extends almost directly forward. The male is larger and instead of a slender beak, has enormously developed mandibles, which are probably of considerable service in excavating the bark preparatory to egg laying and also in the fierce battles individuals of this sex are said to wage. This species is generally distributed in New York State, though rarely met with in numbers, probably because of its retiring habits. This insect may be easily recognized by reference to the accompanying illustration.

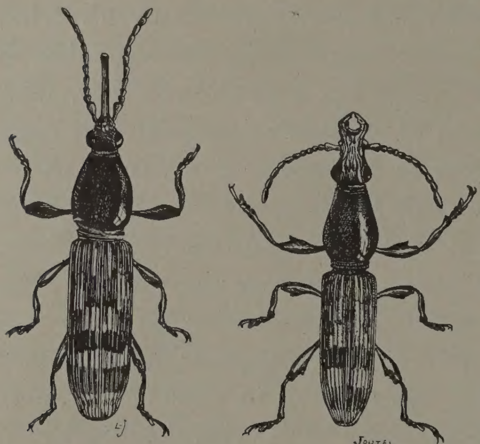

Fig. 45 Northern brenthian, male and female, enlarged (original)

Description. The larva and pupa have been described by Dr Riley as follows:

Larva. Length, .55–.75 inch; diameter in middle of body, .05 inch. Body almost straight, cylindrical, 12 jointed, with a few faint hairs only on prothorax and around anus; thoracic joints short, bent a little forward, swollen and broadly and deeply wrinkled, with two especially prominent swellings on top of joints 2 and 3, converging towards head, and having each a granulated rufous spot; the other joints with about three dorsal transverse wrinkles; joints 5–9 subequal, as long as 1–3 together, twice as long as 4; 10–12 diminishing in length, slightly swollen, the anus retracted; six very small, 3-jointed thoracic legs, the terminal joint being a mere bristle; stigmata quite distinct and brown, the first pair much the largest, between the fold of joints 2 and 3; the others on anterior fifth of joints 4–11, the last pair more dorsal than the rest. Head pale yellow, darker around mouth; rounded, more or less bent over the breast, with sparse, stiff, pale hairs springing from elevated points; ocelli, none; antennae not visible, unless a dusky prominence lying close between mandibles and maxillae be called such; labium small, with two depressions and other inequalities, the margins slightly angular, allowing the jaws to closely fit around it; jaws stout, triangular, the inner margin produced at middle into a larger and smaller tooth, and with a slight excavation near tip; maxillae long, with but a short, horny cardinal piece; the palpi apparently 2 jointed and with difficulty resolved, on account of three or four other prominences around them; garnished on the inside with a close row of stiff hairs and on the outside with two stouter hairs; labium large, oboval, the palpi placed in front and 2 jointed.

Pupa. Average length .40 inch, with the antennae curled back over the thorax, the seven or eight terminal joints each with a more or less distinct, forwardly directed, brown thorn; the snout lying on the breast and varying according to sex; abdominal joints with a more or less distinct row of small thorns on the posterior dorsal edge, the last joint with a more prominent thorn directed backwards in a line with the body.

Life history. The eggs, according to Dr Riley, are laid during the months of May and June. The female bores a cylindric hole in the bark with her slender snout and pushes an egg to the bottom. The operation has been described by Dr Howard, as follows:

> It requires about a day to make a puncture and deposit the egg. During the time the puncture is being made, the male stands guard, occasionally assisting the female in extracting her beak; this he does by stationing himself at a right angle with her body, and by pressing his heavy prosternum against the tip of her abdomen; her stout forelegs serving as a fulcrum and her long body as a lever. When the beak is extracted, the female uses her antennae for freeing the pincers or jaws of bits of wood or dust, the antennae being furnished with stiff hairs and forming an excellent brush. Should a strange male approach, a heavy contest at once ensues, and continues until one or the other is thrown from the tree. The successful party then takes his station as guard.

Dr Riley is of the opinion that the larva lives but a single year, though larvae of different sizes occur in midwinter with the beetles.

Food plants. This insect evidently attacks recently dead and dying trees, preferably oak, though it has been recorded by Dr Hopkins from chestnut, beech, elm, cypress and most other species of deciduous forest trees. He states that the larvae excavate extensive galleries in the solid wood.

Distribution. This species probably has an extended distribution in the northeastern United States, having been recorded by various writers, from New York, New Jersey, District of Columbia and Minnesota.

Painted hickory borer

Cyllene pictus Drury

A blackish, golden marked beetle, about ¾ inch in length, is frequently bred from hickory logs.

This species is somewhat common in New York State, and occurs rather frequently in hickory, it being brought to notice occasionally on account of the beetles emerging in midwinter or early spring from firewood and appearing in houses. This species in the adult condition resembles very closely the insect so common on black locust, and the two beetles may be easily separated by the fact that the hickory borer is rarely abroad, except in the spring, while the locust borers commonly occur in large numbers in the fall. The two forms were confused in earlier days and for a time it was believed that they both belonged to the same species. The demonstration that these two beetles were really distinct species was largely the work of Dr Walsh and to him we owe a carefully tabulated list of differences between the two forms.

Early history. This borer is recorded by Dr Walsh as being rather rare in Illinois in 1866, and he adds that during 17 years' steady collecting he had met with but three specimens. He states that it appeared to be quite common near Philadelphia, where it was said to inhabit the walnut as well as the hickory.

This borer has been recorded by Dr Packard as occurring not only in hickory but also in black walnut, and Dr Lintner in 1893, added butternut to the list of food plants. Prof. Lawrence Bruner writing in 1893, stated that the hickories of Nebraska are very subject to attacks by this species, and Dr A. D. Hopkins records this species in dead branches and small mulberry and hickory trees in West Virginia. He obtained adults Ap. 9 and 14, pupa and larva Ap. 9, and in 1894 he found a fully matured pupa Sep. 24, evidence that this beetle may emerge in the fall. Messrs Webster and Mally have recorded the presence of this borer in Osage orange posts, 1½ feet in length and 4 inches in diameter. A large number of individuals were bred during the months of February, March and April 1897. Dr Lintner, in the same year, called attention to the abundance of these beetles in a house where they bred from firewood, a fact which has been previously recorded. He states that this species is usually rarer than the locust borer. Dr J. B. Smith records this insect as common throughout New Jersey where it breeds in hickory and is often rather injurious.

Life history. The life history of this species has been practically given, so far as known, in the preceding records. The beetles commonly appear in the spring in New York State, oviposit shortly thereafter, and the young bore in the trunk during one season and possibly longer. The winter may be passed in the pupa state as recorded by Dr Hopkins and possibly in the larval form. The characteristic work of this species is shown on plate 15, figures 7–12.

Description. The larva of this species has been described by Dr A. S. Packard as follows:

Larva. Body thick; mouth parts black; head reddish behind the antennae. Prothoracic segment (first behind the head) large and broad, being one half as long as broad; flat and broad above, the upper surface being lower than that of the succeeding segment; the anterior edge thickened, being slightly corneous; a mesial deeply impressed line, especially on the hinder two thirds, where it becomes a broad, deep, angular furrow, dividing the tergum into two quadrant-shaped halves; the outer edge of the segment rises above the flattened tergal portion, which is sparsely covered with hairs, the latter thicker along the sides of the body. The body contracts in width behind the fourth abdominal segment; the upper side of each of the first six abdominal segments (corresponding to those segments in the beetle) is raised into blisterlike swellings, especially on the fifth and sixth segments, which are much narrower than the four preceding segments. These dorsal swellings are smooth and free from fine hairs. Abdominal segments seven to nine convex above, not swollen, and the abdomen is narrowest between the fifth and sixth segments. A pair of large spiracles on the mesothoracic segment, and a pair on each of the first eight abdominal segments.

Antennae three jointed; the two basal joints being of the same length; the basal one being one third stouter than the second; the third joint filiform, and one half as long as the second joint, and ending in two or three hairs. The thin membranous labrum is divided into two parts, the basal solid, the terminal portion forming a movable flap, overlapping and reaching nearly to the end of the mandibles when closed; the basal portion is shorter than broad, being broadly trapezoidal and smooth; the outer division is broader than long, the edges being rounded so that it is almost broadly ovate (transversely) and smooth, covered with long hairs. It is pale membranous with a testaceous hue. Mandibles black, very thick and stout, with obtuse, rounded edges; they are almost as long as the base is broad. Maxillae membranous, flattened, maxillary palpi two jointed. Labium membranous, with a transverse chitinous band near the insertion of the two jointed palpi; both joints short; second one half as thick as the first; edge hairy, the hairs reaching to the ends of the palpi. Length of the body .50 inch; breadth of prothoracic segment, 4.2 mm; breadth of head, 3.2 mm.

The adult beetle is about ¾ inch long, jet-black in color and rather prettily marked with golden yellow lines as in figure. The antennae are a dark brown and the legs a light brown. Dr Walsh states that this species may be distinguished from the closely allied locust borer by its relaxed antennae extending beyond the tip of the wing covers by the entire length of the terminal segment, by the greater robustness of these organs and by the terminal or eleventh segments being fully one half longer than the penultimate and composed of two portions connected by a suture. The wing covers of this species are widened at the base and taper toward their tips, and the second or W-shaped band is whitish instead of yellowish as in the locust borer [pl. 15, fig. 10].

Natural enemies. Dr A. D. Hopkins records Hemirhipus fascicularis Fabr. as attacking the larva of this borer in mulberry and Mr F. H. Chittenden states that Bracon erythrogaster Brulle was reared from hickory wood infested almost exclusively by this beetle.

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Banded hickory borer

Chion cinctus Drury

A brownish beetle about 1 inch in length, may be found on cut hickory the latter part of May, the large, fleshy larvae or grubs making irregular, longitudinal burrows in the wood.

This species is more or less common wherever hickory grows, though it seems to have received comparatively little attention from entomologists. It works more particularly on cut timber, and wood that has lain for a year or two after felling, is frequently so full of galleries that its value, even for firewood, is greatly diminished, while it is entirely worthless for other purposes.

Description. The adult, according to Professor Osborn, is a grayish brown beetle about 1 inch long, commonly with a yellowish, oblique band on each wing cover, a mark sometimes absent. The thorax is cylindric, with a sharp spine at each side and there are two at the extremity of each wing. The antennae of the female are about as long as the body, while in the male they are twice the insect's length.

The full grown grub is fleshy, yellowish, with the thoracic segment somewhat swollen. There are three pairs of very minute thoracic legs. The boring is elliptic in cross section, and in some cases has a longer diameter of ½ inch, and may extend for 3 or 4 inches with the grain of the wood.

Life history and habits. The adult beetles issue about the latter part of May, according to Professor Osborn, single females containing as many as 93 eggs. The insects display marked preference for cut timber. The young grubs commence boring the wood at once and the life cycle is probably completed within two or three years, though instances are on record where beetles have issued from furniture, carriages etc., some years after manufacture. This prolonged larval existence is probably abnormal. The transformation from grub to pupa takes place the latter part of the winter or in the spring, occasionally as early as the first of January. The gallery before and behind the insect is loosely filled with chips prior to the change.

This form is usually recorded as a hickory borer, though Mr Chittenden cites an instance where he reared this species from plum branches badly infested by the fruit tree bark beetle, Scolytus rugulosus Ratz. He also reports it as injurious to all kinds of oaks. Dr Lugger records it from apple, and Dr Hopkins has listed it from chestnut.

Distribution. This species appears to be widely distributed though not abundant in the northeastern United States, having been recorded from Massachusetts, New York, New Jersey, District of Columbia, Ohio and Minnesota.

Preventive measures. This borer displays a marked preference for felled timber, and Professor Osborn states that if the wood be cut in the fall or early winter, so that it becomes thoroughly dry before the beetles appear the following summer, there is much less danger of injury. Peeling the bark is also believed to afford considerable immunity, though this has not been established by experimental evidence. The above statements are based largely on Professor Osborn's account of this insect in *Garden and Forest* for May 1888, p. 148.

Tiger hickory borer

Goes tigrina DeG.

The large creamy yellow grubs of this species may make large holes lengthwise in the inner bark and sapwood of living hickory, oak, and possibly some other trees.

This species has been characterized by Dr Packard, as perhaps the most common borer in hickory and walnut in the Southern States. The young larvae, according to Dr Fitch, live at first on the soft outer layers of the sapwood, mining a shallow cavity about the orifice. The overlying bark dies and turns black. With increase in size and correspondingly stronger jaws, the larva gnaws into solid wood from the upper part of the burrow, boring obliquely inward and upward, all the lower portion being commonly packed with sawdustlike chips. Finally, when the grub has attained full growth, the upper end of the burrow is extended outward to the bark, in order that the adult may readily escape from its burrow.

Description. The adult has been characterized by Dr Fitch, as a long-horned beetle about 1 inch long, brown, covered with an incumbent, short, tawny, gray pubescence, more dense on the wing covers, which latter have a broad, dark brown band beyond their middle and another on their base. The thorax has an erect blunt spine on each side, and the antennae are pale yellowish except for the dark brown first joint.

Food plants. This species has been recorded by Dr Hopkins, as mining the inner bark and sapwood of living hickory and oak, while Mr Beutenmuller states that it works in the solid wood of hickory, oak and walnut, seeming to prefer white oak. This species is probably more destructive south of New York.

Hickory saperda

Saperda discoidea Fabr.

A large, white, legless grub, making good sized galleries in bark and sapwood, is very likely to be this insect.

This species is a rather common borer in hickory, though ordinarily it does not cause a great deal of damage. It frequently follows the work of the destructive hickory bark borer, Scolytus quadrispinosus Say, and is occasionally so abundant that a piece of bark 6 inches square may contain a dozen or more larvae. It is remarkable in having the sexes so unlike that one unacquainted with it, would certainly consider them distinct species. There are individuals to be found having the same color and markings as the females, and some very poorly developed specimens of the latter entirely lack the characteristic markings of the sex.

Life history. The beetles occur abroad the latter part of June and in July. The larvae feed partly on the bark and partly on the wood, and on approaching maturity enter either the bark or the wood and transform to beetles. Nothing is known concerning the duration of the life cycle or method of oviposition.

Food plants. This species has been recorded from the walnut as well as hickory. It does not appear to infest other trees.

Description. The female is about ¾ and the male about ½ inch in length. The former may be recognized by the yellowish thorax and the yellowish markings on the brownish wing covers, while the latter has a black head and thorax and uniform gray wing covers.

Distribution. This species has been recorded from Canada south to Louisiana and as far west as Nebraska. It is probably generally distributed in the northern United States, at least.

Remedial measures. As in the case of other borers, it is manifestly impossible to do much except for the more valuable trees. The attack may be prevented to a large extent by keeping the trees in thrifty condition, as this insect exhibits a marked preference for unhealthy or diseased tissues. Digging out the borers may possibly be of some value.

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Red-edged saperda

Saperda lateralis Fabr.

This species is about the same size as the common elm borer, S. tridentata Oliv., and like it occurs in the elm. Its principal food plant is hickory, it being partial to injuries near the roots and infests the base of sprouts on recently cleared lands.

The beetles occur in June in northern localities, and like most Saperdas feed on the bark and stems of leaves at the ends of shoots. We have bred this species from hickory stems in which the larvae lived at the juncture of dead and living bark. They have also been recorded as inhabiting the base of dead shoots. Dr Packard states that he has reared this species from alder, but this habit seems to be exceptional. It rarely causes serious injury.

Description. The adult is a black beetle with the wing covers, thorax and head margined by a broad red line and a central one along the suture.

Distribution. This species ranges from Canada southward to Pennsylvania and westward to Nebraska. It appears to be widely distributed in the northeastern United States.

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Twig girdler

Oncideres cingulatus Say

Girdled and occasionally severed twigs and branches of various trees, may be the work of a thick bodied, long horned beetle measuring from a little over ½ to nearly ¾ inch in length, with the wing covers of the male irregularly dotted with faint, tawny spots.

This beautiful species was described by Say in 1826, who stated that it was not common and occurred on hickory. It was noticed by Dr Fitch in 1859, as a hickory insect. The work of this interesting girdler in hickory, was brought to the attention of Messrs Walsh and Riley in 1868, who were at first unable to identify it, and afterwards recognized the depredator as this species, and on looking over the literature, they ascertained that its curious method of operation had been previously discovered by Haldeman. This insect has been repeatedly noticed in various parts of the country, specially because of its curious method of operation, and particularly in the Southern States, where it appears to be more abundant and destructive than farther north.

Description. The egg has been characterized by Professor Parrott, as white, elongate, oval in shape, with the ends obtusely rounded, indented with slight longitudinal depressions, and about 1/11 inch long by one fourth as wide.

The newly hatched larva has been described by him as a soft, fleshy, legless grub slightly covered with light colored hairs. It is about 1/10 inch long, somewhat shiny, white, with its mouth parts slightly tinged with brown. When full grown it is about ¾ inch in length, nearly cylindric in form, tapering a little posteriorly and swollen at the anterior extremity, within which the small head may be retracted. The mandibles are then light brown, shading to almost piceous at the tip. The other mouth parts are yellowish, except for some brownish colored notches. "On the upper and subdorsal portion of the epicranium, near anterior margin, is a row of short, parallel, chitinous ridges, interrupted at the middle by the dorsal suture. Upon the dorsal surface of each segment of the mature larva, commencing with the third and ending with the tenth, and on the ventral side of each segment, commencing with the second and ending with the tenth, appears a slight swelling containing a double, transverse row of toothlike projections, from twelve to eighteen in number, sometimes with a few odd ones in front of each row." [*See* pl. 9, fig. 12]

He has described the pupa as yellowish white and about ¾ inch in length: "The antennal sheaths arise from the notch on the inner, upper half of the eyes, and crossing them, pass down along each side of the back, over the wing sheaths and just above the sheaths of first and second pairs of legs, and then turning inward, pass back toward the mouth parts, where they turn outward, forming a circle over the sheaths of first pair of legs. The first and second pairs of legs are above, and the third pair with exception of tarsi are below the wing sheaths. On the inner and upper margin of the base of the antennal sheaths is a short, slightly curved, hornlike protuberance, pointing backward and outward. Small, brownish, sharp points occur on the following parts of abdomen: the swellings which appear on the side of each abdominal segment with exception of the first, the upper surface, and posterior margin of anal segment, which is thickly fringed with sharp, excurved points."

The adult insect, as previously stated, ranges in length from a little over ½ to nearly ¾ inch. It may be easily recognized by reference to plate 9, figure 6.

Life history. The first contribution to the life history of this insect, was by Professor Haldeman, as mentioned above, but it is to Messrs Walsh and Riley that we owe our first illustration of the insect and its work, and a somewhat detailed discussion of its life history. The adult beetles occur in Pennsylvania, according to Haldeman, during the last two weeks in August and the first week in September, feeding on the bark of the tender branches of young hickories. This insect has been the subject of close studies in Kansas, by Messrs Scheffer and Parrott, who worked independently. Professor Parrott has observed the girdling of the twig, and states that the female selects a twig seldom more than ½ inch in diameter, and does not make a complete circle at once but cuts section by section, as if cutting as deep as the edges of the groove will permit her. One section after another is thus cut till the twig is girdled, the entire operation taking 12 hours in some cases. These gentlemen state that the eggs are deposited beneath the bark of the girdled branches and just at the base of side shoots or aborted buds. Usually there is but one in a shoot, but in case the latter is large there may be two or three. Professor Parrott states that often two, sometimes four or five eggs are deposited, and in a number of instances they are placed at the side of and above the offshoot. A dozen or more may be found on a single branch. Mr Scheffer states that the egg protected with a gummy cap, is deposited in a puncture which has an oval aperture. It lies just under the bark, or in some cases between the layers of the bark. He also states that no punctures were found on side shoots, while Professor Parrott has observed a number. There appears to be no fixed rule regarding places where eggs may be deposited. They hatch in from three to four weeks after the branches drop, the young appearing as very small, cream-colored, footless grubs, which do not increase much in size before winter. Professor Parrott states that a few of the insects pass the winter in the egg, and that the larvae make little growth during this time. With the approach of warm weather they commence to eat and grow rapidly. The grubs become full grown about the middle of July, according to Professor Parrott, at which time they make a pupal cell at one end of the channel. This stage lasts about two weeks and the adults appear in Kansas between July 18 and Aug. 3. The characteristic work of this species is shown in plate 9, figures 6–12.

Injuries. Occasionally this species becomes quite destructive, as was the case in Kansas in 1894 to 1898, at which time elms in certain sections of the State suffered very severely. Professor Atkinson, in 1889, stated that this species attacks hickories and elms particularly in North Carolina, and that in some seasons it causes much injury. Serious damage to hickory, pecan and persimmon have also been reported from Mississippi.

Food plants. This borer has been known as the hickory and also as the elm twig girdler, these common designations indicating the trees most likely to suffer from its injuries. It has a considerable range of food plants, and in the South is injurious to the persimmon, oak, pecan, and is known as a depredator on apple, pear, quince, peach and orange trees. It has also been observed girdling rosebushes.

Distribution. This insect has been recorded from most of the eastern and central United States, though it appears to be rare in Minnesota and some of the northern states, while in the South its work is more abundant. Dr J. B. Smith has listed it from several New Jersey localities, where it is recorded as girdling twigs of oak, hickory, persimmon and a number of fruit trees.

Remedial measures. It is comparatively easy to control this insect, because the winter is passed in the twigs lying on the ground, and in the case of valuable trees on lawns and in similar localities, it would not be difficult to collect and burn them at any time during the winter or early spring.

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Hickory snout borer

Magdalis olyra Herbst.

A black, long snouted beetle about 3/16 inch in length, breeds commonly in dying or dead hickory limbs.

Examples of this species were bred from hickory limbs taken at Ilion N. Y., in August 1902. The tree was badly infested with a gnarly growth and presumably in poor condition. We have also met with it in large numbers in recently cut hickory limbs.

Description. The beetle is about 3/16 inch in length, jet-black, with the thorax angulated anteriorly, coarsely punctured; wing covers deeply grooved by nearly confluent series of punctures. The grub is a short, white, fleshy larva closely resembling that of the pine weevil and of other species of Magdalis.

Life history. This species appears to confine its attacks very largely to diseased and dying trees and is sometimes present under the bark in enormous numbers, at which time the inner bark and sapwood may be almost riddled by the many irregular, anastomosing galleries.

Food plants. This species is credited by Dr Packard with boring in oak as well as in hickory. It appears to prefer limbs from 4 to 6 inches in diameter, though it has also been bred from small twigs.

Distribution. Dr Horn states that this insect has the same distribution as M. barbita Say, which latter he records from Canada, Pennsylvania, Georgia and Dakota, and adds that this form is rare in the Southern States. This weevil is common in the northeastern states, since it has been recorded in a number of local lists, most of them also stating that it breeds in hickory.

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Hickory bark borer

Scolytus quadrispinosus Say

Small brown or black beetles, about 1/5 inch in length, make longitudinal burrows from which small legless grubs excavate galleries at nearly right angles. The beetles work also in the leaf petioles, and on the young twigs, causing the wilting of the foliage in midsummer.

The hickories of the Genesee valley were very seriously injured and many succumbed in 1901 to the deadly work of this bark borer. The damage was brought to public notice by Hon. W. Austin Wadsworth, formerly president of the New York State Fisheries, Forest and Game Commission, whose handsome estate of over 5000 acres is adorned with a large number of hickories, many of which have already been killed by this insect. The trouble was first observed on Mr Wadsworth's estate in 1898 and 1899 at which time many trees died; others perished in 1900 and large numbers in 1901. A personal investigation late in the fall of 1901 convinced us that 90 to 95% of the hickories in one woodland of about 200 acres in question had been killed by this borer. In fact so many of these trees had been destroyed that it was difficult to find one uninjured. This attack extended at least two miles north and south of the village and it is not improbable that a much larger area may have been seriously affected by this pest.

An examination by Mr M. F. Adams of Buffalo, Aug. 16 and 17, 1901, showed that nearly every hickory was more or less infested or had been killed, that the beetles were mostly dead at that time and that the secondary galleries made by the grubs were from 1½ to 2 inches long. He also observed that the females entered green living tissues by preference and that a large proportion of the hickory foliage had been destroyed at that time by the beetles burrowing the leaf petioles and twigs. Black walnut twigs had also suffered to some extent.

Earlier injuries. The outlook for hickories in that section of New York State is not very encouraging if we may judge from the previous records of this insect. The attention of the late Dr Riley was called in 1867 to the very destructive work of this insect about Princeton Ill., where it had destroyed hickory trees for the previous 10 years and in 1872 the injuries caused by this beetle in Washington county, Mo., were brought to his notice. This pest is recorded as having caused considerable damage about Newark N. J. from 1891 to 1894, at which latter date general alarm was felt on account of so many trees dying. It was reported as quite injurious about Crafton, Alleghany co., Pa. in 1894. The next year or two it must have caused considerable mischief as the trouble was noticed in the report of the Pennsylvania Department of Agriculture for 1896 and there this insect was characterized as the most destructive bark beetle in Alleghany county where it had caused the death of a large number of hickories.

Mr C. W. Johnson observes in this report that the borer was most destructive in woods where the underbrush had been trimmed out and it may be well in this connection to notice that practically the same conditions obtain among the infested hickories at Geneseo.

Professor Osborn records considerable injury to hickory and walnut trees in Iowa about this time, the leaves of all being cut off more or less and some 8 inch shell bark trees killed.

Life history and habits. The life history of this borer may be summarized as follows. The beetles appear from the last of June to the last of July and may be found in New York State up to the middle of August. They bore young twigs, terminal buds and green nuts, evidently for food, and in this manner they frequently cause the wilting of leaves and the death of twigs. They attack the bark of the trunk and the larger branches in July, each female making a vertical gallery an inch or more in length and along the sides of which she deposits in small notches 20 to 40 or 50 eggs. The parental galleries are frequently very regularly placed on the tree one above another. The eggs soon hatch and the grubs work in the tissues at first at nearly right angles to the primary galleries but those at the extremities soon diverge from the others till they run nearly parallel with the wood fibers. The larval galleries rarely cross each other. Winter is passed by the grubs in a nearly full grown condition. They transform to pupa the last of May and the beetles appear about a month later. [*See* pl. 39, fig. 4 for method of work in trunks]

Prof. J. B. Smith of New Brunswick has expressed the opinion that two broods of this insect may occur in Pennsylvania but no other writer has observed anything which indicated more than one annual generation and the latter seems to be true in New York State at least.

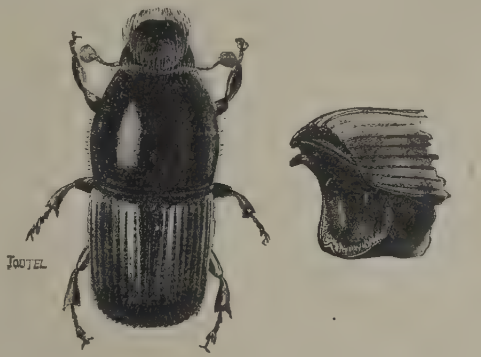

Fig. 46 Hickory bark borer from above and side view of the posterior extremity of the male (original)

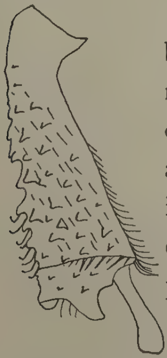

Fig. 47 Middle tibia of hickory bark borer (original)

Description. The adult insect is a small brown or black beetle about 1/5 inch in length. This species is more easily recognized by its characteristic work in hickories as the differences between the adults of the various forms are not very apparent to other than experts. The grubs are about 1/4 inch in length, white with brownish heads and powerful dark colored jaws. The structure of the antennae is shown at plate 67, figure 15.

Signs of injury. The preliminary signs of injury are exceedingly important because they frequently tell of the trouble before it has passed the remedial stage. Wilting leaves and dead twigs in midsummer are the principal indications of the beetle's work though this is not usually observed till the trees begin to die at the top from no apparent cause. Examination of the infested bark may reveal parental galleries 1 to 1½ inches long with diverging, dilating larval galleries and if the brood has completed its transformations, portions of the bark will be dotted with holes, such as might be made with no. 8 buckshot, through which the beetles have escaped.

Natural enemies. This insect has a number of natural enemies but unfortunately in the case of the Geneseo outbreak they appear to be relatively scarce. There are three very small four winged flies which breed on the grubs in their galleries. They bear the scientific names of Spathina trifasciata Riley, S. unifasciatus Ashm., and Lysitermus scolyticida Ashm. We obtained examples of the Spathius from infested wood from Geneseo. Another four winged fly known as Bracon scolytivorus Cress. also breeds in this insect and appears to be one of the forms we reared. A predaceous bark beetle, Clerus ichneumoneus Fabr., preys on this species and is probably the form we found in association with this borer.

Remedial measures. Previous records indicate that such attacks may extend over a series of years and result in the death of a very large proportion of the trees in a locality, and nothing but the prompt execution of drastic measures over the entire infested area would avail much when the pest is abundant over large areas. It has been shown that the insects spend most of their lives boring the inner bark and outer sapwood and are therefore mostly within the tree and hence inaccessible to attack unless the trees are cut and the infested bark removed. It is not enough to simply cut the trees. The removing of the bark will cause the death of most of the borers but more thorough work will be accomplished by burning the infested limbs and trunks before the beetles emerge in June. Thoroughly infested trees and affected portions of others are doomed and therefore it can hardly be considered a loss to cut them at once while a great risk is taken if they be allowed to remain, thus rearing hosts of beetles which may be expected to attack other trees the following summer. The more valuable trees should have all their infested branches cut away and burned. It might pay in the case of highly prized individuals on lawns to spray them about the middle of May with arsenate of lead, using one of the prepared paste forms at the rate of 6 to 8 pounds to 50 gallons of water and taking special pains to cover the twigs and base of the leaf stalks with the insecticide. The object of this is to kill the beetles as they begin to gnaw their way into the twigs and leaf stalks. Similar treatment of the limbs and trunk might aid to a considerable extent in preventing the entrance of the beetles though it would require very thorough work, as the insects usually enter the tree from under some projecting scale of bark, a place where it would be very difficult to put the poison. Our principal dependence must be in the destruction of the infested trees.

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Banded ash borer

Neoclytus capraea Say

Logs of black ash and dying trees are frequently seriously injured by borers belonging to this species.

This insect has been known for years, and Dr Riley has placed on record an instance of serious injury presumably by this species. Mr Shelby Reed of Scottsville N. Y., in 1880 referred briefly in the *American Entomologist*, to a widespread destruction of black ash forests in his vicinity by an insect which was probably this species. The beetle may be recognized by the following description:

Dark brownish purple, head and thorax darkest; eyes nearly circular, behind them a narrow yellow border; thorax barrel-shaped, deep purple, surrounded by three very narrow yellow lines, one at each end and one in the middle; scutel yellow; wing cases crossed by three yellow bands; first, a semicircular band from the scutel running backwards and round up to each shoulder; then another of similar shape about the middle, with the circle reversed; then a straight band, and a strong spine at the tip of each; length, ½ inch; width, 1/7 inch.

It is separated, according to Professor Wickham, from allied forms, by the femora not being spinose, its falciform antennae and the many strongly elevated, though more or less confused transverse ridges on the thorax, in connection with its apically rounded elytra and the yellowish, transverse bands forming an oval figure at the base of each, behind which are two slightly oblique fasciae. This species is reported as rare in New Jersey. It has been listed from the District of Columbia, where the adults were found on flowers and trees, and Dr Hopkins has taken it in West Virginia. The latter reports it as very injurious to dying trees and sawlogs of black ash, the larvae making numerous holes in the wood. Mr Beutenmuller, in addition to the food plants given above, records it also from the limbs and trunk of elm and hickory.

Two-lined chestnut borer

Agrilus bilineatus Weber

This white, flat headed grub makes very tortuous interlacing burrows under chestnut and oak bark.

This species was brought to the writer's attention in November 1901, because of severe injury to oaks at Geneseo. Several large trees had been killed by the work of this borer and examination of the infested bark showed that the inner layers were very badly riddled by the interlacing galleries of this insect.

Early history. This species is comparatively unknown to economic entomologists. It was recorded by Dr Packard as occurring under the bark of an oaktree at Providence R. I. He found pupae May 30, and beetles were common on the leaves. Mr Adams Tollman of Concord Mass., reports taking over 100 specimens of this beetle on white oak June 15, 1885, and Dr A. D. Hopkins, writing of this insect in 1894, states that different species of oak in and around Madison Wis., were seriously affected by this borer which caused the death of isolated trees and groups of trees. He also noted what appeared to be the same trouble at different points through Ohio, Wisconsin and Indiana, and later in West Virginia observed a number of trees dying in the same manner. He found the larvae mining the inner bark and outer sapwood and from his observations was led to believe that the insect was capable of attacking and killing healthy oak and chestnut trees. Two years later he states that this species was responsible directly or indirectly for the death of a great quantity of oak and chestnut timber not alone in West Virginia, but in different sections of the country between there and the Mississippi river. Prof. C. W. Johnson in 1896, found that the red oak near Natrona, Allegheny co., Pa., were dying at the top, and examination showed that the bark of the living portion of the tree near the top was a complete network of Agrilid burrows, probably this species, scores of larvae being found in the inner bark. Mr W. H. Harrington in the same year, records taking this insect on beech, and expresses the belief that it infests this tree. This beetle was the subject of an extended notice by Mr F. H. Chittenden in 1897, and from his account many of the following facts are taken. He records injury to chestnut trees by this species in Botetourt co., Va. in 1891, and the following year to chestnut in the District of Columbia. His attention was called in 1893, to serious injuries in Virginia in the vicinity of Washington D. C., and investigation showed that this insect had inflicted considerable loss. He states that the chestnut was almost universally infested and that the majority of the trees had been recently killed. The damage was estimated at about 50%, and Mr Chittenden further states that a similar condition existed in neighboring forests of the surrounding region.

Life history and habits. This species operates just under the bark of the tree, making galleries which run mostly across the grain, and when completed are from 6 to 10 inches in length. The result is that a tree seriously infested is very quickly girdled. The larval galleries were observed by Mr Chittenden from the base of the tree well upward toward the top.

The life history of this insect has been summarized by him as follows: The adult beetles appear in the District of Columbia during May and the early part of June, their emergence varying according to season and locality. Eggs are deposited on the tree and the larvae work under the bark in the manner described above. The following spring they construct a chamber which in living trees, so far as observed, is always in the bark, and in the case of small dead trees in the wood. The final transformations take place in cells thus formed. The pupal stage lasts about two weeks and then the beetles appear. Mr Chittenden records this species as infesting the white, scarlet and yellow oaks.

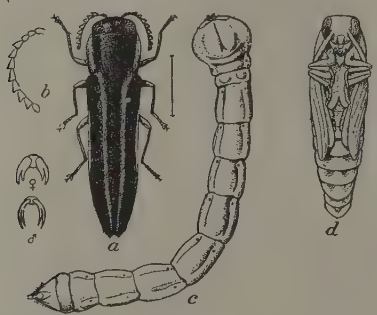

Fig. 48 Agrilus bilineatus: *a*=adult beetle, enlarged; *b*=antenna of same, enlarged; ♀=claws of posterior tarsi of female, somewhat enlarged; ♂=same of male, somewhat enlarged; *c*=larva, enlarged; *d*=pupa, enlarged. (After Chittenden, U. S. Dep't Agric. Div. Ent. Cir. 24, 2 ser. '97)

Description. The beetle is nearly 3/8 inch in length, elongate and subcylindric in shape. It is black with a more or less greenish tinge, and the thorax is clothed with a light golden yellow pubescence, and the wing covers are each marked with a stripe of the same color. The larva or borer is long, slender, considerably flattened, and a milk white or yellowish color, except the mouth parts and the peculiar anal forks which are dark brown. The pupa is white like the larva.

Distribution. This species is a native insect and has been recorded as occurring from Maine and Massachusetts, southward to Texas and westward to the Rocky mountains.

Natural enemies. A single parasite, Spathius simillimus Ashm., has been bred from this insect in considerable numbers. Mr Chittenden states that it was exceedingly abundant in the District of Columbia during the two years this borer was destructive. Another parasite was reared but has not been identified.

Preventive or remedial measures. An infested tree can not be saved and for the sake of others it should be cut before the appearance of the beetles, and the bark at least destroyed by burning. Clean culture, which in this instance would mean the removal of dying or dead limbs or injured trees, would do much towards preventing injury, as it will naturally tend to reduce the numbers of this pest.

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Thorn limb borer

Saperda fayi Bland

Oval swellings with four to five longitudinal scars occurring on the small limbs and stems of wild thorn, are the work of this species.

This little borer is local and badly infested thorntrees may be only a short distance from others entirely free from attack. It appears to be widely distributed in New York State, and should this species, like its allies, acquire a taste for cultivated fruit trees it would probably not be a dangerous enemy, as its galls indicate the presence of the borer and they could easily be cut off in time to destroy the contained insects.

Life history. The beetles appear during the last week in May or the first of June at Allegheny Pa., the males preceding the females by three or four days. They do not appear to eat and are short-lived, the whole brood, excepting stragglers, emerging and disappearing within about 10 or 12 days. The insects fly but little and usually oviposit on the same tree they inhabited as borers and drop to the ground and conceal themselves whenever disturbed. Oviposition probably occurs at night, and limbs from 1/3 to 1 1/4 inches in diameter are selected. Three to six longitudinal incisions about 3/4 inch long, equally distant and parallel one to another, are made through the bark and an egg placed in each. The larva bores underneath the outer layer of the wood for a distance of perhaps 1/8 inch and uses this as a retreat from which it feeds on diseased wood caused by the incision. The gnawing of the larvae results in an increased flow of sap and the development of the gall. The borers are about 1/4 inch in length at the beginning of the winter, at which time they retire a little further into the wood and close the opening of the burrows. When in thick limbs two or three bore obliquely till they reach the center or near it, and then proceed up it two or three inches, the galleries of different burrows being parallel but not communicating. Dr Hamilton calls attention to the fact that larvae near the center are larger, and he believes that only they attain maturity, though in our experience the different sizes indicate the sexes and unless parasitized all emerge. The larvae feed the second summer and hibernate in pupal chambers near the center and emerge the following spring. This insect and its work is shown on plate 6, figures 20–25.

Description. The beetle is a cinnamon brown, white marked insect with one elongated spot near the middle of the wing covers and a nearly circular one toward the apex.

Distribution. This species has been recorded from Canada, New York, New Jersey, Pennsylvania and Ohio, and appears to be limited in its range to the northeastern United States.

Natural enemies. Infested limbs are frequently investigated by woodpeckers and undoubtedly many larvae perish owing to the activity of these beneficial birds.

Remedial measures. It should be comparatively easy to keep this insect in check by cutting away the galls and burning them before the insects have an opportunity to escape. The only objection is that this procedure would be likely to mar the symmetry of the tree.

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Bronze birch borer

Agrilus anxius Gory.

A flattened whitish rather delicate grub, about ¾ inch in length, with a large flattened head, may be found boring the inner bark of white and other birches.

The work of this destructive borer was brought to the writer's attention in 1898, because of its serious injuries to white birches at Buffalo. Numerous specimens of the insect and its work, together with observations regarding its habits, were received from Mr M. F. Adams of that city in 1899 and 1900, and injury to cut leaved birches was reported from Rochester. A serious difficulty at this time with white birches in St Lawrence county, was considered as probably the work of this species.

Early history. This insect was till recently comparatively unknown to economic entomologists. The first record concerning its habits is that given by Dr Lintner, in his report as state entomologist for 1883, published in the 37th annual report of the State Museum. Dr Lintner states that he met with this insect on some cut poplars piled by the wayside. The beetles were observed alighting from flight in the bright sunshine and running actively about. 62 specimens were taken at the time, and Dr Lintner adds that the larvae is probably a borer in poplars. Dr Fred Blanchard in 1889, records the taking of a few specimens of this insect on the summit of Mt Washington N. H., where they had flown from below, and states that the form described occurred in Massachusetts on poplar sprouts and trunks. Prof. G. C. Davis records this species as making galls in branches of the willow, Salix discolor. Prof. Davis describes those made by this birch borer as an oval swelling on the stem, very similar to the one made by Saperda concolor, found at work on the same trees. He states that the latter insect remains mostly within the swelling and makes its exit from it, while this species excavates an oval gallery downward from the gall, sometimes in the pith, but oftener indiscriminately through the wood and emerged therefrom, frequently ½ inch below. Mr E. A. Schwartz mentions this species as injuring birch in connection with Xyloterus politus in 1890, and Mr J. G. Jack in 1896 records injury to birch trees in the Arnold Arboretum, by what is probably this insect.

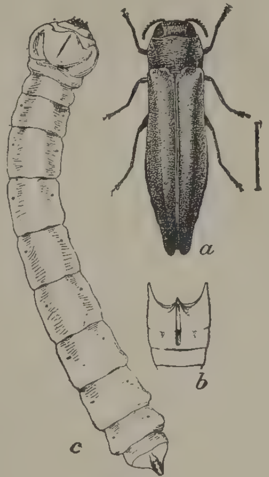

Fig. 49 Bronze birch borer: a=female beetle; b=first abdominal segments of male from below; c=larva from above, all enlarged about 3½ times. (After Chittenden, U. S. Dep't Agric. Div. Ent. Bul. 18, n. s.)

Description. The adult beetle is moderately robust, olive brown, and is from 3/10 to nearly ½ inch long. The general form of the insect is well represented in the accompanying illustration. The white pupa is about ½ inch in length, rather slender, and tapering to tip of the abdomen. The grub or larva is nearly ¾ inch in length, creamy white in color and with dark mouth parts. It will be observed that the flattened head is only slightly wider than the abdominal segments. The tip of the larva is armed with a pair of linear, serrate chitinous bars.

Distribution. The distribution of this insect as given by Mr Chittenden is as follows: Mt Washington, Boston, and Jamaica Plain Mass.; Adirondacks, Elke Lake and elsewhere in New York; Alleghany Pa.; Lake Superior, Marquette, Detroit, Agricultural College and Port Huron Michigan; Stony Creek Va., and Province of Quebec near Ottawa.

Life history and habits. The larvae or borers winter under the bark. They begin to transform to pupae in the early part of May. Mr Adams states that larvae had straightened out though none had assumed the pupal form May 5, 1900, and that on the 27th some had changed color. Most of the pupae were a pure white on this later date, though a very few had commenced to color. June 3, no beetles had emerged, and more of the pupae had assumed a dark color. May 29, 1899, he removed some adult beetles from birch, and found many pupae, and few larvae. June 2, beetles began to issue from dry sticks, and on July 14, he found some young larvae about ¼ inch in length at work in the cambium layer, at which time they had traveled some distance. The presence of this insect may be detected by the reddish discoloration of about ¼ inch in width, caused by the exudation of sap and the ejection of excrement. The dying of the tops of infested trees is another characteristic [pl. 40, fig. 1]. The borer first attacks the tops, killing the upper limbs, while the lower branches remain green. Its presence is also indicated by uneven, wavy appearances on the bark, showing more or less regular spiral ridges on the smaller branches. The burrows of this insect are very irregular and interlace in a most perplexing manner. Plate 40, figure 2, is a photograph taken by

Mr M. F. Adams, and represents the intricate manner in which this insect operates. The larva enters the wood in the fall and constructs a cavity which probably serves the purpose of a pupal cell, where it undergoes its final transformation in late spring or early summer. This insect, so far as observed by Mr Adams, deposits no eggs in branches smaller than ½ or ¾ inch in diameter.

Food plants. This species has been recorded by Mr Adams as infesting the black birch, yellow birch, and the cut-leaved birch, and as previously noted, Dr Lintner has observed it on poplars and Professor Davis has recorded it from willow.

Natural enemies. One of the common woodpeckers, probably the hairy woodpecker, Dryobates villosus, feeds quite extensively on the larvae of this pest. This bird is said to select a place on the trunk of the tree in which the larvae are concealed, and makes an incision in the bark such as that made by a penknife driven straight into the tree. This it does till it locates the borer, when it proceeds to pick open the bark and remove the grub.

Preventive measures. It seems very probable that a portion of the injury is due to carelessness in failing to remove the lower part of the trunks of infested trees. Mr Adams states that in some instances the upper portion of the tree was cut, and about 6 feet of the trunk was allowed to remain as a support for flower vases or for some other purpose. The leaving of such a trunk would be very favorable for the pest, and undoubtedly results in the breeding of large numbers. Nothing better can be suggested than cutting and burning the infested trees, or portions of the same, before the beetles appear in the summer. The application of an insect lime such as dendroleon would hardly be advisable in the case of a light colored tree like the birch. It may pay to band more highly prized trees with paper during the latter part of May, allowing the wrapping to remain for a period of two or three months.

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Dark elm bark borer

Hylesinus opaculus Lec.

Making small, pinholelike perforations in elm, particularly diseased bark in August and September, a minute, cylindric, dark brown bark beetle about 1/10 inch long, its wing covers marked with deeply impressed, punctured furrows and bearing short hairs.

This species mines under the green bark of elms, particularly those in a sickly or dying condition. It is not, as a rule, injurious.

Description. This beetle has been described by Dr LeConte as follows: "Cylindrical, brownish black, opaque, thinly clothed with short stiff yellow hairs; antennae and feet ferruginous; head convex, thickly punctured; prothorax nearly as long as wide, narrowed in front, side subsinuate near the tip; densely but not finely punctured, with a very narrow faint dorsal carina; elytra with striae composed of deep subquadrate punctures, intervals narrow, rough with transverse rugosities." The antennal structure is shown on plate 67, figure 6.

This species has been recorded from the Middle States and Pennsylvania by Dr LeConte, and Dr Smith lists it from New Jersey, where it is said to mine the green bark of elms.

Ash timber beetle

Hylesinus aculeatus Say

A small, brownish, rather stout, cylindric beetle bores commonly in freshly cut ash.

This species is our most common ash borer, and specimens may be found wherever ash posts have been split in the spring of the year. The main adult burrow is usually excavated in the inner bark and sapwood by two females working in opposite directions from the entrance point, which latter is usually indicated by a slight notch. The compound main gallery is from about 1 inch to nearly 4 inches in length, and eggs are deposited at short intervals on each side, young larvae making their gradually dilated burrows at approximately right angles to the parental groove. The lateral burrows are from about ½ to nearly 2 inches in length.

Description. This beetle has been described by Zimmerman as follows: "Of the same form as the European H. fraxini but smaller; blackish brown, thickly clothed with very short ashy squamiform hairs; antennae and feet ferruginous; a large spot on the middle of the prothorax and the side margins are blackish brown; upon the elytra the fifth interval from the base to the middle is blackish brown, the color is then divided into two branches, and prolonged obliquely to the suture; the humeri are ferruginous; the rows of small acute elevations on the intervals of the elytra have suggested the name of this species." Dr LeConte states that in well preserved specimens, beside the two oblique bands behind the middle, there is a third one very near the tip and with the sides of the elytra also dark colored.

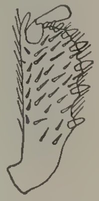

Fig. 50 Middle tibia of Hylesinus aculeatus much enlarged (original)

Distribution. Zimmerman records this species from the Northern States and LeConte from Massachusetts to Texas, Kansas and Oregon. Dr Smith states that it is common in New Jersey on cut ash and that it mines under green bark.

Apple wood stainer

Monarthrum mali Fitch

A minute reddish brown, cylindric beetle, about $^{3}/_{32}$ inch in length, sinks small cylindric galleries in dead beech, spruce and other trees.

This little borer was taken by the writer Aug. 21, 1900, at Floodwood, in a fallen beech which had begun to decay. It was also found by him on the 22d at Axton, working in the stump of spruce 6 or 8 weeks after cutting. This species was met with by Dr Fitch in 1855, working in young thrifty appletrees. He states that the attack is characterized by the trees putting forth their leaves in the spring and then suddenly withering, as though scorched by fire, the bark becoming loosened from the wood, and soon after numerous pinlike perforations appearing in the bark of wood, from each of which emerges an example of this beetle. He adds that he knew of the insect only by specimens recently received from Middlefield Mass., from Lawrence Smith, who states that he took them July 6 from the trunk of an apple tree 10 inches in diameter, which was badly riddled by the burrows of this insect. It is probable that the effects described above were the result of some other agency since this species operates almost entirely in the wood. Mr E. A. Schwartz has observed this species at work in red oak at Washington D. C., and Dr LeConte states that it ranges from Lake Superior to Florida.

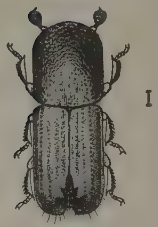

Fig. 51 Monarthrum mali (After Hubbard, U. S. Dep't Agric. Div. Ent. Bul. 7, n. s. 1897)

Description. The parent beetle is a minute reddish-brown, cylindric insect, about 3/32 inch long. The shape of the antennal club, the puncturing of the prothorax and the linear dotting of the elytra are well shown in figure 51. Structural details of the first are shown on plate 67, figure 1. The elytral declivity is slightly excavated and marked by two rather inconspicuous teeth on each side.

This insect enters the dying or dead tree vertically for a distance of about ¼ inch and from that point inward branches may diverge at oblique angles. The brood chambers are nearly ⅜ inch long and extend vertically above and below the main branches [*see* fig. 53].

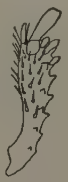

Fig. 52 Middle tibia of Monarthrum mali, much enlarged (original)

Food plants. Mr H. G. Hubbard states that this species attacks oaks, hickory, beech, maple, aspen, apple and orange, and that the list might be extended to include hard wood timber. Dr A. D. Hopkins has recorded this insect as occurring in West Virginia in pine, white oak, black oak, red oak, jack oak, elm, beech, maple, chestnut, bass wood, honey locust, yellow poplar or tulip, buckeye, morello cherry, red cedar and hemlock.

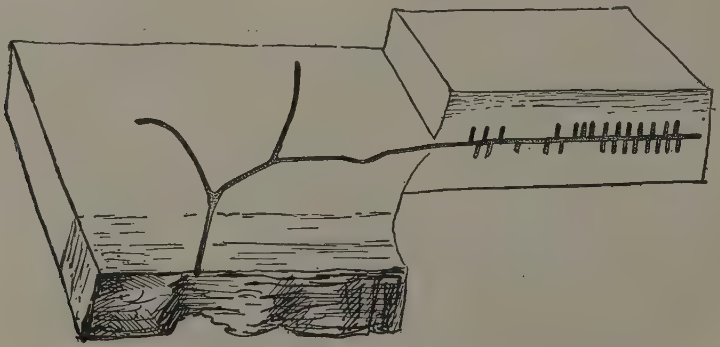

Fig. 53 Galleries of Monarthrum mali in maple. (After Hubbard, U. S. Dep't Agric. Div. Ent. Bul. 7, 1897)

Life history. Mr H. G. Hubbard has made some interesting observations on the life history of members of this genus. He states that the males assist the females in forming new colonies, and that the young are raised in separate pits or cradles which they do not leave until maturity is attained. The galleries constructed by the female beetle, extend deeply into the wood with their branches mostly in a horizontal plane, figure 53. The mother beetle deposits her eggs in circular pits which she excavates in the galleries in two opposite series parallel with the grain of the wood. An egg is deposited in each and the cavity packed with chips taken from the fungus bed on which ambrosia had begun to grow. The young grubs eat the fungus and eject the refuse from their cradles. At first they lie curled up in the pit made by the mother, but as they grow larger they deepen the cradles with their own jaws till when full grown they slightly exceed the length of the fully extended grub. The young swallow the wood which they excavate. It passes through the body unchanged in texture and is excreted in pellets stained a yellowish color. A portion of the excrement is evidently utilized to form the fungus or food bed. The mother beetle is constantly in attendance on the young during their developmental period and guards them with jealous care. The mouth of each cradle is closed with a plug of the food fungus and as fast as this is consumed fresh material is supplied. The grubs perforate the plug from time to time and clean out their retreats by pushing the pellets through the opening. They are removed by the mother, and the opening again sealed with ambrosia. The transformation to the adult occurs in these lateral galleries or cradles.

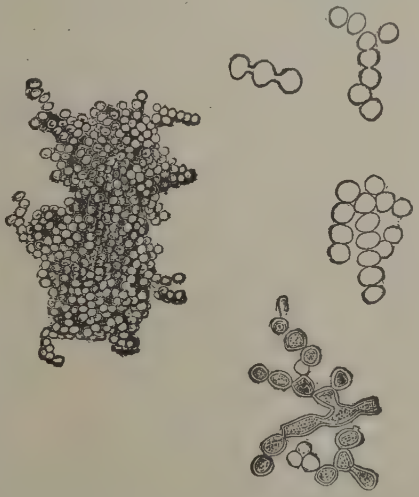

Fig. 54 Ambrosia of Monarthrum mali, greatly enlarged. (After Hubbard, U. S. Dep't Agric. Div. Ent. Bul. 7, n. s. 1897)

Mr Hubbard states that the habits of Monarthrum fasciatum Say and those of this insect are identical and that they feed on the same fungus and are commonly associated in a tree, not seldom occupying galleries having a common entrance. He adds that both species are known to attack wine casks and that they probably breed only in dying trees.

Dr A. D. Hopkins has recorded this, among other species, as being attracted to a freshly painted geenhouse evidently by the odor of turpentine.

Natural enemies. Only one natural enemy so far as known to the writer, has been recorded. Dr A. D. Hopkins states that he found the predaceous beetle, Colydium lineola Say, with this species in jack oak.

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Xyloterus politus Say

A small light brown to nearly black, cylindric beetle, about ⅛ inch long, frequently enters the exposed wood of various trees.

This is apparently the more common species of this genus in New York State. It was taken by the writer at Floodwood, Aug. 21, 1900, in a fallen beechtree which had begun to decay, and also on Aug. 23 in the stump of a recently fallen soft maple at Axton. Newly transformed pupae were present in the brood chambers in the latter instance. This insect has been recorded by Dr Hopkins as occurring in the following trees: beech, black oak, white oak, red oak, hemlock, sugar maple, red maple, chestnut, magnolia, elm, hickory, ash, birch and black spruce. Mr E. A. Schwartz has also recorded this insect as infesting ash-leaved maple and box elder, Negundo aceroides. It will be seen by the above that this species is not closely limited in its selection of trees, and it appears very probable that the condition of the trunk has much to do with its being attacked.

This borer is stated by Mr Hubbard to infest the sapwood of deciduous as well as coniferous trees. He adds that it has a wide distribution in the diversified forest region of the eastern United States, and adds that it is a dangerous enemy to smooth barked trees whenever they become weakened, injured or shaken by storms.

Description. This beetle is more slender and a little smaller than Xyloterus bivittatus Kirby. It varies in color from light brown to almost black, is cylindric in shape, about ⅛ inch long. The form of the antennal club, and the sculpturing of the dorsal surface is shown in figure 55. This species and the following have divided eyes, the two divisions being some distance apart and connected only by a narrow, dark strip, best seen in recently transformed, light colored individuals. The galleries of this insect may extend to some depth in the wood, lateral burrows being given off at intervals and the brood chambers occurring very close together, almost like the cells of a honeybee. The walls of the galleries and brood chambers are a deep black as in the case of allied species. The antennal structure is shown on plate 70, figure 4.

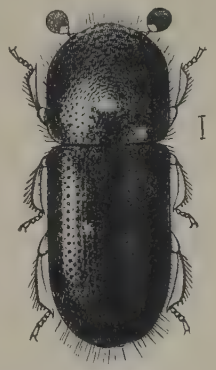

Fig. 55 Xyloterus politus. (After Hubbard, U. S. Dep't Agric. Div. Ent. Bul. 7, n. s. 1897)

Natural enemies. A predaceous beetle, Colydium lineola Say, has been recorded by Dr Hopkins as occurring in the burrows of this species. Another small beetle, Ips sanguinolentus Oliv., has been found by Dr Hopkins in association with this species feeding on the sap of sugar maple.

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Xyloterus sp.

A beetle belonging to this genus was met with by the writer at Saranac Inn, Aug. 20, 1900, in white birch, where it was working in partly dead wood.

Fully developed beetles were found in many of the side galleries, while numbers were empty.

The burrows of these beetles are about medium size, and the brood chambers are placed less than their diameter apart, in the specimens examined.

Xyloterus sp.

This rather stout species was taken Aug. 20, 1900, from the trunk of a partly decaying paper birch at Saranac Inn. There were many fully developed beetles in the brood chambers. The same insect, in all probability, was found Aug. 23 working in the dead, nearly dry limb of a yellow birch at Axton.

Description. The head, prothorax and ventral surface of this beetle are black. The wing covers are a dark, sooty yellow bordered with black. It is a rather stout species a little over 1/8 inch in length. The legs vary from an amber to a black, the tarsi usually being amber.

The burrows of this species penetrate, like others, some little distance before branching. The brood chambers are alternating and about 1/8 inch apart.

Xyloterus sp.

The work of a member of this genus was met with by the writer at Axton, Aug. 23, 1900, in a dead limb of a yellow birch. The tree was nearly dry when it was discovered. The burrows of this species are of a medium size and the brood chambers in the specimen examined were placed at a distance greater than their diameter from each other.

Xyloterus sp.

A cylindric, stout brownish black beetle, makes somewhat large galleries in stumps of poplar, Populus grandidente.

This species was met with by the writer in August 1900, at Axton, where it was running galleries in a stump of a tree cut about a year ago. This species is a large, rather stout one, and its galleries of a corresponding size, being nearly 3/32 inch in diameter.

Minute oak bark beetle

Pityophthorus minutissimus Zimm.

A minute slender, dark brown beetle, about 1/16 inch long, sometimes riddles the dead inner bark of red oaks.

This species was found by the writer in great numbers at Manor, Oct. 3, 1900, mining the bark of piled red oak cord wood which was probably cut the preceding winter. Dr A. D. Hopkins has recorded this species as infesting black oak, white oak, jack oak, chestnut oak and dogwood, and he has observed a chalcid fly attack the adults. This species has also been recorded by Dr Riley as mining the dry oak bark.

Description. The adult is a small, rather slender dark brown beetle, about 1/16 inch long. The head is ornamented with two bunches of yellowish, curved hairs. The prothorax is rather coarsely tuberculate and the wing covers or elytra are very finely striated. Certain structual details of this beetle are shown on plate 67, figure 11, and its method of work on plate 39, figure 1.

The beetle runs its galleries transversely to the bark fibers, depositing eggs on either side, the young hatching therefrom work at nearly right angles to the parental grooves and therefore nearly parallel to the grain of the wood. This insect, when present in numbers, soon riddles the bark and as the numerous exit holes allow ready access to moisture, decay soon follows. This can hardly be considered a species of much importance, except as it aids in hastening the decay of the wood, since it apparently confines its operations to dead bark.

A small beetle, Silvanus surinamensis Linn., was reared from a piece of infested bark, and it was evidently living on either decaying vegetable or animal matter, rather than preying on this bark borer.

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Pityophthorus sp.

A dead piece of black birch was found by the writer Aug. 5, 1900, which showed the work of this interesting species. The central chamber, as in the case of some allied species, opens into primary or egg galleries which run in the sapwood across the grain and are directly opposite each other. The specimen in hand, a twig about 1¼ inches in diameter, was half girdled by one pair of these galleries which are less than 1/32 inch in diameter. The larval galleries are near together, dilate gradually, are somewhat tortuous, follow the grain of the wood, and may attain a length of 1¼ inches. They lie largely in the inner bark toward their extremity and the wood is scored somewhat.

Powder post beetle

Lyctus unipunctatus Herbst.

Fine, white dustlike borings and numerous minute holes in well dried hard woods are good indications of the presence of this little brown insect ¼ inch long.

This species is well known as destructive to seasoned woods and occasionally it makes its appearance in very unexpected localities. The writer's attention was called to this beetle in June, 1899, on account of its operations in some boards forming part of a carriage. Prof. G. C. Davis, formerly connected with the Agricultural College of Michigan, records this insect as infesting floorings in the college hall which had been laid two years before. He states that the beetles issued from the sapwood only and were probably in it at the time the lumber was sawed, and Dr J. B. Smith has noted an instance of this species emerging from a seasoned mantel which had been varnished. This insect is much better known as a pest of such well seasoned articles as wheel spokes and tool handles. The beetle has been bred from the branches of several species of oaks and from hickory, and Dr Hagen records it as injuring supple jack, a vine imported from Jamaica. Dr J. B. Smith states that it occurs in dry wood often after the latter has been manufactured into furniture or trim-

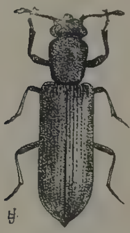
Fig. 56 Powder post beetle, much enlarged (original)

ming and Mr D. W. Coquillett has found this insect in dead grapevines and obtained it from an orangetree which had been cut down two years previously. He has also bred it from dry sycamore wood. Dr A. D. Hopkins states that this species infests, in addition to those given above, seasoned locust and wild cherry, and he likewise records it as injurious to stored handles, spokes and hoops. Prof. F. M. Webster states that in 1891 his attention was called to a peculiar condition of affairs in western Ohio. A complaint was made that the borer was eating not only shop floors of a manufacturer of agricultural implements but also the posts that supported the floors of the different stories. Professor Webster was able to trace the origin of the trouble to a lot of oak timber that had been piled in the yards for the purpose of seasoning and ascertained that the insect had been brought into the building as the wood was carried inside for the purpose of working it up. He states that the borer appeared to attack only the sapwood of the open floor, and would riddle this no matter where it was located, whether it was in the floor of a storeroom where it was quiet, or in portions that were constantly shaken by the rumble of machinery. A thin paper covering was left untouched on the post, while all of the sappy part within was soon reduced to powder. Professor Webster states that the larvae appear to burrow usually parallel with the grain of the wood and that they pupated in a chamber without forming a cocoon. He bred from this insect a little honey yellowish parasite, Hecabolus lycti Cress., in large numbers.

Remedial measures. Various remedial measures were recommended and tried with varying success. Professor Webster summarizes the results as follows:

> Kerosene applied to the posts had little effect, and in the paint shop the frequent rubbing of paint brushes over the surface of posts did not appear to inconvenience the borers. The only place where they did not appear to depredate was in the basements, which were of necessity more or less damp. On the floors kerosene oil was effective for a time, but later investigations have shown that in time this would all evaporate and the beetles would then attack the wood a second time. The only application that was thoroughly effective and also a protection from subsequent injury,

was a very thin mixture of turpentine and asphalt, or coal tar. This was applied to the posts and pillars by boring small holes obliquely inward and downward and then filling them with the mixture, which would quickly penetrate the powdery mass in the burrows, not only killing all life with which it came in contact, but also carrying with it the asphalt, thereby rendering the uneaten portion permanently distasteful to the insects.

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Small red horned borer

Ptilinus ruficornis Say

A small dark brown beetle, about 3/16 inch long, with bright rufous antennae, may be found boring in wood of various kinds.

This species was brought to the writer's attention July 11, 1900, by the receipt of a number of examples from Saranac Inn N. Y., accompanied by the statement that birch and maple floors were severely injured in some of the cottages.

This beetle also infests trees where the wood has been exposed, and it has even been found in kindling wood. Mr W. H. Harrington states that he has seen great numbers of these insects issuing from maple trees which had been riddled with small holes. He states that these beetles are very common and attack various trees, both living and dead. He adds that when a tree, such as an oak, hickory or maple has been injured by blazing or peeling off the bark, this little beetle may frequently be seen boring into the exposed wood, or if the injury be an old one, possibly numbers may be found emerging.

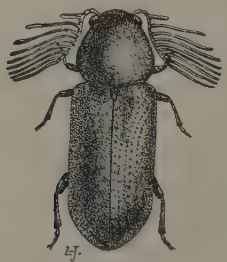

Fig. 57 Small red-horned borer, much enlarged (original)

Mr W. L. Deveraux is said by Dr Packard to have found larvae of this insect in great abundance in timber, logs and cord wood. He states that it deposits its eggs in the summer in which the tree is cut and that many generations follow each other for a number of years in the same log. Dr A. D. Hopkins records this species as infesting dead or dry wood where the bark has been removed on living trees, logs and stumps of beech, wild cherry, cultivated cherry, maple and ironwood, and states that he has met with the adults in February, April, June and July.

The adult insect is a dark brown beetle, about 3/16 inch long and with bright rufous antennae, which are remarkable in the male because of the extremely long lamellae or pectinations, those of the female being strongly serrate. The immature stages have not been met with by the writer.

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European willow gall midge

Rhabdophaga salicis Schrk.

European willows are attacked by a small black midge which produces irregular, somewhat fusiform galls inhabited by yellowish, jumping larvae.

This is another imported species which has apparently become well established in this country, it having been found in considerable numbers in the vicinity of Rochester N. Y. during the last four years. It was brought to the writer's attention by Mr H. C. Peck, a nursery inspector, sending infested willows with an inquiry as to the cause of the trouble. Repeated efforts to ascertain the identity of the species met with failure, till early spring of 1902, when living material was sent to Prof. J. J. Kieffer, a well recognized authority in this group, who kindly determined the insect.

Injuries. This pest produces many celled galls in the stems of small willows which are grown by nurserymen for the purpose of tying stock into bundles. These abnormal growths make the willows brittle and consequently unfit them for binding purposes. This species may eventually prove a very serious pest to growers of willow for basket purposes, as infested shoots could not be used in this industry any more than for tying trees.

Introduction. This insect was doubtless introduced with imported nursery stock. Some infested willows were probably used to bind imported trees into bundles, and this is borne out by the fact that the locality where the flies were found is in close proximity to a place where an importer had been in the habit of unpacking stock.

Life history. Adults were bred from infested galls collected early in the season, from May 22 and onward. Other specimens received directly from the field, June 3 were disclosing flies, showing that in nature the adult issues at this time. The pupa, like those of many Cecidomyiids, wriggles partly out of the gall before disclosing the adult, and so many may emerge from a gall that it presents a somewhat peculiar appearance after the flies have escaped because of the numerous white, projecting pupal cases.

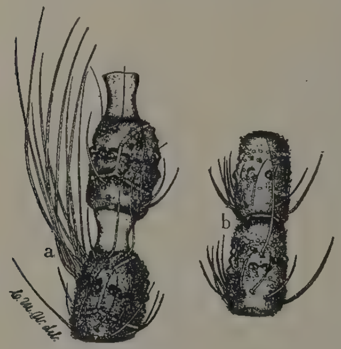

Fig. 58 Two antennal segments of European willow gall midge; *a*=male; *b*=female; both much enlarged

The reddish orange eggs were deposited by captive flies on the leaves in irregular clusters or groups of three to six or more. The duration of the egg stage and of the larval existence was not determined. It seems probable that there is but one annual generation.

Description. The small black or dark brown flies are about ⅛ inch in length. The eyes are black, finely granulated, emarginate anteriorly, confluent in the male and nearly so in the female. The male antennae are 17 jointed and are about the length of the insect and the female antennae are about half her length. The interesting structures occurring on the segments of the male and female antennae are shown in figure 58. The thorax is ornamented with two converging rows of silvery hairs, and a short row of smaller ones occurs on each humeral angle. The metathorax is tipped with a transverse row of the same vestiture. The venation of the wings, which are sparsely covered and well fringed with dark hairs, is represented in figure 59. The balancers or halteres are slender and tipped with yellow. The legs are very slender and long, claws bifid, toothed, and with well developed empodium. The distended abdomen of the gravid female is dark red with its load of eggs. The abdomen of the male is nearly black and the claspers are tipped with very short, minute teeth. The puparium is subconic, about ⅛ inch long, with the anterior two thirds dark straw color, and the posterior third dark rufous. The antennae and prominent dorsal processes of the pupa are represented in figure 60. The pupal mandibles are four toothed, tipped with light brown, chitinous, and the ventral tooth is nearly twice the size of the one next to it, which in turn is larger than the others, all curve some and taper to acute points.

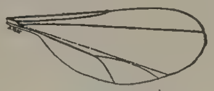

Fig. 59 Wing of European willow gall midge, much enlarged

The larvae is stout, orange red, with 11 easily distinguished segments. It is ⅛ inch long, and the "breast bone" or sternal spatula is nearly black, enlarged slightly at both extremities, and two toothed anteriorly.

The reddish orange eggs are lanceo-elliptic in outline, and are about 1/75 inch in length.

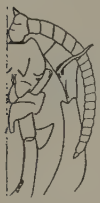

Fig. 60 Pupal skin of European willow gall midge, much enlarged

The gall occurs on the smaller shoots of the willow, and is a more or less irregular enlargement about ½ inch in length [pl. 50, fig. 4]. The bark from the infested portions turns brown or black before the insects appear, and the pupal case remains protruding from the empty gall.

Parasites. Several parasites were reared by the writer from this species and they have been kindly identified by Dr Ashmead, through the courtesy of Dr L. O. Howard, as follows: Tridymus salicis Nees, a species not previously known to occur in America; Tridymus metallicus Ashm. was bred in small numbers from galls received in the spring of 1902, and Polygonotus salicicola Ashm., was reared in considerable numbers. The presence of several parasites, and the abundance of at least one, leads to the hope that natural agents will soon control this pest.

Remedial measures. There is apparently no better method of checking this insect than by cutting and burning the infested shoots in early spring. If this is thoroughly done for a few years it should result in reducing the number of this pest materially.

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Willow shoot sawfly

Janus integer Nort.

Sudden wilting of terminal shoots may be caused by this insect girdling the twigs after depositing her eggs.

This species has been known for some years in New York State as an enemy of currants, on account of its girdling habit, causing the tender terminal shoots to wilt. This sawfly has been recorded as inflicting considerable damage to both willow and poplar in Washington D. C., and in Maryland. The attack begins near the tips of the young shoots, causing them to hang down, turn brown and dry during the day. In one instance an entire field was so severely injured that it looked as though it had suffered from severe frost or as if a fire had run over it, and the insect was so abundant that by fall large numbers of the shoots had been killed down close to the ground. Similar injury has been observed by Mr W. F Hubbard to basket willows in portions of the states of Kentucky, Indiana and Ohio, and it would not be surprising were the species to become more or less destructive in this way in New York State, though up to the present no report of such damage has been received.

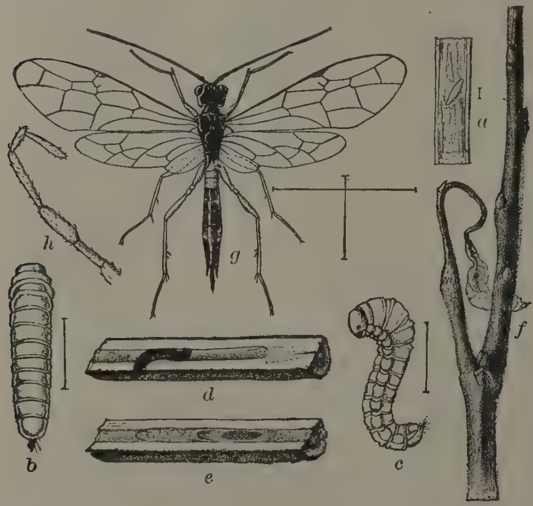

Fig. 61 Willow shoot sawfly: *a*=egg; *b*=larva, dorsal view; *c*=same, side view; *d*, *e*=two views of burrow; *f*=twig showing damage; *g*=adult—all enlarged except *f*—*h*, antenna, still more enlarged (After Riley)

Description. The adult insect is a rather slender, four winged wasplike creature with a wing spread of nearly 1 inch and a body length of a little more than ½ inch. It is black, excepting the broad orange band at the base of the abdomen. The larva or borer is about ⅜ inch long when full grown, legless, white, and with the thoracic segments slightly thickened.

Life history. The adult is abroad in early spring, and after depositing her eggs in a shoot, the female proceeds to girdle the stem below the point of oviposition, in order to prevent its further growth and thus protect the eggs from being crushed. The larvae gradually work their way downward through the pith a distance of two feet or more, and by the beginning of November have completed their growth and filled the lower ends of their burrows with frass or castings. They then gnaw a passage to the bark through one side of the shoot a little above where the pupal cell is to be formed. Within the latter they construct a delicate, transparent, cylindric cocoon in which they winter. The transformation to the adult occurs the following spring.

Remedial measures. The wilting shoots are an early sign of injury, and where the expense is not too great, the insect can be easily controlled by cutting them off below the injured point and allow them to drop to the ground. This procedure prevents the further development of the insect and affords parasites, if present, an opportunity to escape.

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Black walnut caterpillar

Datana integerrima Grote & Robinson

Reddish, white striped or blackish, white haired caterpillars, from ¾ to 1½ inches in length, feed in large clusters in midsummer on black walnut, butternut and other trees.

This species is the more common one of the genus found in New York State on black walnuts and hickories. It has been brought to the writer's attention a number of times during recent years, and in 1902 he observed that the caterpillars were quite abundant on the black walnuts and butternuts in and about Westfield. It was so numerous as to threaten the entire defoliation of many trees, and from statements made by residents it would appear that this is a not unusual condition. The work of the same species was observed in 1901 in and about Barker's N. Y.

Description. The eggs are deposited on the underside of the leaves in closely packed masses of 300 and over. They are rather small, elongate, hemispheric approaching cylindric and with the apex somewhat flattened. The color is a dull white and the surface somewhat roughened and with regular markings. Diameter less than 1/35 inch.

The recent hatched larva has been described by Dr Packard as about 1/5 inch in length, with a brick-red body, having a faint subdorsal and a lateral yellowish stripe along the body and a diffuse spiracular yellowish line. The head, the distinct prothoracic shield and the true legs are black. The third stage has been described as nearly 3/8 inch in length, of a deeper reddish color, and with the yellowish lines more distinct, while the spiracular line enclosing the distinct black spiracles is a pale lilac.

The stage preceding the final one has been described by Mr Beutenmüller as follows:

> Head and cervical shield jet-black. Body deep reddish brown, with three very fine narrow, sordid white stripes along each side, and a broader one below the spiracles, which are black, and another stripe along the middle venter. Thoracic feet, extremities of abdominal legs and anal legs jet-black, shining. The body is covered also with sordid white hairs. Length 32mm.

The same writer's description of the last stage is given herewith.

> Body wholly jet-black, and covered with very long flosslike, sordid white hairs, becoming yellowish as the larva undergoes its changes to the pupa. Thoracic feet black, shining. Abdominal legs black outside and reddish brown on the inner side. Length 55mm.

These two descriptions agree entirely with the larvae observed by us in such numbers on black walnut and butternuts.

The adult insect is a brownish gray moth, having a wing spread of from about 1¾ to 2 inches, and with the forewings marked by a series of curving transverse lines. The prothorax bears a conspicuous mass of long scales bordered laterally and posteriorly with light gray [pl. 15, fig. 4].

Life history. The life history of this species is about as follows. The eggs are deposited in early August and the larvae may be observed during that month and September. They enter the ground after attaining full growth and transform to pupae within oval cells in the earth. The moths are stated by Dr Packard to appear in May and August, and this apparently indicates two broods, which may be true in the more southern portions of this insect's range but we have failed to note any signs of more than one generation in New York State.

Food plants. This insect prefers the black walnut. It also feeds on butternut, hickory and walnut, and has been recorded on beech, oak, willow, honey locust, thorn and apple.

Distribution. This species has apparently a wide range in the eastern United States at least, and has been recorded from Maine south to West Virginia, and westward to Kansas and Arkansas.

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Hickory horned devil

Citheronia regalis Fabr.

A large, bluish green caterpillar, with four conspicuous hornlike projections on the thoracic segments, and a number of smaller near by, occurs in September on hickory and other trees.

This, one of our largest native caterpillars, is a rare species in New York State. It feeds on hickory, also black walnut, and butternut, and has been recorded as occurring on persimmon and sumac.

Description. The full grown caterpillar is a magnificent creature, and may measure 5 inches when extended in its crawling attitude. Its general color is green with a yellowish cast. On the thoracic segments there are eight serrate horns, four small and black and the other four quite long, orange brown or red with black extremities. The adult moth is one of our most magnificent insects and may have a wing spread of about 6 inches. It is reddish brown with bright brick red markings and may be recognized by reference to plate 43, figure 3.

The larva is generally feared and in Virginia it is known as the hickory horned devil, an appellation which does not appear to be limited to that section of the country. The appearance of the caterpillar renders people very timid in handling it, though as a matter of fact, it is harmless. The pupa is black, short and thick, and may be found under ground. The moths appear during the last half of June. This species is very rarely abundant enough to cause material injury.

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Yellow striped oak caterpillar

Anisota senatoria Abb. & Sm.

A black spiny caterpillar with four orange yellow stripes on the back, and two along each side, frequently strips the foliage from scrub and other oaks in August.

This insect is extremely common on the scrub oaks at Karner, where it annually causes considerable injury. It is not unusual to see from one half to two thirds of these oaks stripped of foliage the latter part of August, or in early September, and more or less dead sprouts occur in that section as a result of this insect's work. The two scrub oaks, Quercus ilicifolia and Q. prinoides have very little commercial value, and the abundance of the insect in this locality can not be regarded as a serious evil. This pest however, attacks valuable oaks, as observed by the writer in 1900 on Long Island, and its depredations on such may cause considerable loss.

Early history. The attention of Dr Fitch was attracted to this insect in the latter part of August 1858, when he observed large numbers of the caterpillars in a cemetery at Saratoga where they had stripped most of the leaves from the oaks, and were at that time descending the trees probably in search of food elsewhere as few of them appeared to have attained full size. They were observed by him crawling on the surface of the light, sandy soil, and on the sides of monuments. Dr Lintner in 1889 records this species as being very abundant annually at Karner up to within recent years. The cause for their being fewer then was attributed to the destruction of their food plants by extensive fires. An earlier abundance of this insect was brought to Dr Lintner's attention by Dr James Eights, who stated that on one occasion the caterpillars were so exceedingly numerous on and about the railroad tracks between Albany and Schenectady, that the rails had to be sanded before the trains could run. This species was very abundant at Livingston, Columbia co., in 1882, as recorded by Mr Clarkson, who states that the caterpillars appeared the latter part of June, and before the middle of August had consumed all the leaves of young oaks, and had injured many of the older trees in lawns and on the borders of forests. The report of the United States Commissioner of Agriculture for 1869 contains the statement that "for 3 years the oaks near Kalamazoo, Michigan, have been entirely deprived of their leaves, and nearly all the trees attacked have died." Professor Claypole records great injury by this insect at New Bloomfield Pa., in 1882. He states that he had seen hillsides which looked as if fires had passed over them. Caterpillars were found crawling over almost every square inch of ground, and lying dead in dozens in every pool of water.

Life history. The moths appear in the latitude of New York State about the second week in June. The eggs are placed in large irregular clusters on the underside of the leaf. As many as 500 or more may occur in a single cluster as stated by Dr Lintner, though in our own collections, clusters between 200 to 300 were more commonly met with. The color of the eggs may vary from a clear white to a dull coral red. They hatch in from about a week to 10 days, and the yellowish caterpillars with their prominent black spines just behind the head, feed side by side in closely massed clusters. July 19, 1901, the writer observed many of these caterpillars feeding on oaks at Karner. Their presence at this time could easily be detected by the partly stripped branches, and also by the fine brownish excrement on the foliage below. They were so abundant that leaves covered with the little pests were easily found. The portion of the foliage on which the eggs were laid was usually untouched though everything else, and the adjacent leaves had been eaten. The small caterpillars at this time were about ¼ inch long, and larger, darker ones, about ½ inch in length, were also observed. A lot of these latter were placed under observation and July 23, another molt occurred. The caterpillars were then coal-black, with bright red longitudinal stripes, and the thoracic horns considerably longer than in the preceding stage. July 27, caterpillars in at least three different stages were easily found at Karner, entire shoots had been defoliated and the younger caterpillars were frequently clustered on the under surface of the leaves. The larger larva at this time measured about 1 inch in length. Sep. 6, practically all the larvae had transformed to pupae. Dr Lintner has given the following as a summary of the life history. He states that they molt four times, the average period between each being about 9 days. Oviposition extends over a period of 3 or 4 weeks, consequently larvae may be found in several stages. Notes made by him in 1869 show that on Aug. 20, the larvae were small, some passing through their fourth molt and others in their last stage. Aug. 27 some were full grown, Sep. 8 mature larvae were found wandering prior to pupation, on the 14th, full grown larvae were still abundant, and on the 30th a few were seen. He states that the larger number probably enter the ground for pupation during the second and third weeks of September. They bury themselves to a depth of 3 or 4 inches and make a simple cell in which the final transformations take place.

Description. The moth is a bright reddish yellow color, with its front wings specked with black dots, and a large white spot near the middle. The female has an expanse of about 2½ inches, and the male about 1½. The latter is darker in color, and has the antennae broadly pectinated for more than half their length.

The following description of the larval stages is taken from Dr Lintner's account.

The very young larvae are black, pale yellow in color with a few short hairs, and on the second segment there are two straight subcylindrical black horns arising from a green base, and with a slight enlargement at the apex, which bears two black diverging setae about two thirds the length of the horns.

The larva in its second stage is an obscure green with seven dark lines of which the dorsal and the stigmatal are narrower, and the subdorsal ones each include a row of short spines. The thoracic shield, the anal segment and the true legs are black and the prolegs with a black spot laterally.

The third stage larva is about $\frac{1}{3}$ inch in length, head and thoracic shield glossy black, horns slightly spinose, enlarged at the tip and usually with apical spines. The abdominal stripes are black, with yellow brown between. The terminal segment is spinose and glossy black.

The fourth stage larva is about $\frac{6}{10}$ inch in length, glossy black and with eight yellow stripes. The horns are slightly tapering, clubbed at the tips, and $\frac{1}{5}$ inch in length.

The fifth stage larva has the head, thoracic shield, horns, anal shield, and legs shining black, and the body is covered with minute elevated points.

The full grown larva is about 2 inches long, about the thickness of a lead pencil, cylindrical, and of a coal-black color, with orange yellow stripes. It may be recognized by the aid of plate 17, figure 4.

Natural enemies. This species is the prey of a number of natural enemies. Its spines probably protect it somewhat from insectivorous birds, though Prof. A. J. Cook has recorded the robin and blue jay as feeding on it. One Hymenopterous parasite, Limneria fugitiva Say has been bred from this insect. Dr Lintner records the rearing of another parasite from this species, but unfortunately did not identify it. A young soldier bug, Podisus placidus Uhl., was observed feeding on the eggs of this pest.

Distribution. This species is recorded as far less abundant in the Southern States than in the North. Its eastern range is apparently from Canada to Georgia and westward. It has been reported from Wisconsin, Missouri, Kansas, and California. It is a rather local insect and Dr Fitch states that he never met with it at Salem, where he resided, when it was very abundant only 25 miles distant. Dr Lintner adds that during many years collecting he had never seen it numerous in any other locality than at

Karner. The writer met with this insect in considerable numbers at Manor, Long Island, in 1900, but aside from that has not seen it in any other place than the above mentioned locality.

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Buck or Maia moth

Hemileuca maia Drury

Small black spiny caterpillars occur in early summer feeding in company on the leaves of various oaks, particularly in swampy places.

This interesting species is one of the rarer forms met with in New York State. It was observed by Dr Lintner in early May 1869, at Karner, where he found a belt of eggs encircling a small twig of the bear or black scrub oak, and a colony of the insects were discovered by the writer in the same locality in 1902. The habit the larvae possess of feeding in company for a time and their large size as they approach maturity, makes the species a conspicuous one. The handsome moths are counted desirable additions to a collection.

Early history. This species was noticed in the early half of the last century by Dr Harris, who records it as a very rare moth in Massachusetts. It is stated to be more abundant in Illinois and Missouri, where it is called the buck or deer moth because of its flying late in autumn when deer run. The range of this species is given by Dr Packard as from Maine to Georgia, and westward to Kansas. It has also been rarely found west of the Rocky mountains at Dayton Nev., flying about willows in August. Dr Packard states that it occurs in California. Specimens from this latter place apparently agree, as stated by Dr Riley, with those reared by Dr Lintner in New York.

Life history. The life history of the insect may be summarized as follows. The moths begin to issue from the ground late in September and early in October in the Central or Eastern States. The males almost always appear first, as stated by Dr Riley, and in some instances emergence has been retarded a whole year. The eggs are deposited in small masses encircling twigs, the smallest number in one being 70 and ranging from that to 200. The deposition of the egg has been described by Dr Riley as follows:

> Holding firmly by all her feet, the female stations herself upon a twig, with her head usually toward the end. She then stretches her abdomen to its fullest extent and fastens the first egg; another is then attached by its side, and so on, the body reaching round the twig without letting go the feet. In this manner, governed by the thickness of the twig, an irregular, somewhat spiral ring is formed and others added, until toward the last the abdomen is raised and the ovipositor brought up between the legs. The lower or first deposited ones incline so as to almost lie on their sides.

Dr Lintner states that the eggs are firmly united to one another and to the twig by a glutinous matter in which they are enveloped. This substance forms rings of black around the points of attachment of the eggs to the twig, and at the places of union between the eggs it assumes a reddish color. The young larvae hatch the latter part of May. Dr Lintner records the appearance of some on the 27th in 1869, and adds that their escape from the shell was, without a single exception, from the apex through a regular elliptic opening eaten by the larvae. The translucent or brownish yellow egg shells remain on the stems. The caterpillars feed ravenously. Those reared by Dr Lintner attained maturity July 17, entered the ground soon after and by the 22d, one had transformed to the pupa and the last by Aug. 1.

Food plants. This species has been recorded by Dr Riley as feeding on the leaves of our different oaks, and he adds that the larvae "are sometimes quite abundant on the young post, black and red oaks along the Iron mountain region." He also found them abundant on the scrub willow, Salix humilis in Northern Illinois and on a rosebush, and he states that it occurred on the common hazel, while Glover has recorded it as living on the wild black cherry. Dr Lintner states that this species probably feeds on most, if not all, of our oaks and that the larvae were readily changed from one species of oak to another.

Description. The moth is a beautiful blackish insect [pl. 17, fig. 9] with wings so thinly scaled in places that they appear semitransparent. They are ornamented with creamy white bands which are broadest on the hind wings. The male may be recognized by its broader black antennae and the smaller abdomen tipped with a large tuft of red hairs. The egg belts [pl. 17, fig. 10], range in length from ¼ to a little over ½ inch, as stated by Dr Lintner, and contain from 70 to 200 eggs. The egg is about 1/20 inch long, obovate, compressed on the sides, and at the apex reddish brown above and yellowish white below, as described by Dr Riley. The following description of the various stages is abbreviated from Dr Lintner's account.

The recently hatched larva is at first reddish and then changes to nearly black and is about ⅛ inch long. It is adorned with five to eight rows of glossy black spines, each bearing four diverging spinules and a curved, ciliated bristle nearly double the length of the spine.

The young larva after its first molt is about 3/10 inch in length, has a shiny black head and a few black hairs. The body is black, and when highly magnified is minutely granulated. The spines are glossy black, with three or more branches, in the truncated tip of which is inserted a bristle about ⅓ the length of the spine. The spines of the two anterior segments are longer than the others. On segments 3 to 7 inclusive in the two superior rows, the main spine (which is trifid on segment 3, bifid on segment 4, and simple on segments 5 to 7) is acutely terminated, while its branches have the termination and armature of those elsewhere.

The larva in the second molt has a rufous head, and a fuscous body with obscure red stigmatal spots sprinkled with rufous granulations, of which there is a larger one laterally on each segment below the subdorsal row of spines. The spines and their branches are fulvous, those of the two superior rows tipped with a bristle, often black and numerously branched; the lateral spines less branching are tipped with longer fulvous bristles.

The legs and prolegs are rufous, and three hours after the molt the larva had changed to a uniform reddish brown color.

The caterpillars after the third molt are about 1 inch in length, of a fuscous color, and with the spines on the two superior rows on segments 3 to 10, and the median one on segment 11, red, with their terminal third black, simple, fasciculate, thickly radiating from a black, slightly elevated tubercle, the other spines are glossy black, branched and whitish near their tips. Spiracles linear and tawny.

The caterpillars after their fourth molt are about 1$\frac{1}{10}$ inches long, and on emerging from the old skin, the head and all the spines are pale red. After a few hours the head becomes a reddish brown and the spines their normal color. The body is black, with numerous small whitish, oval papillae, each bearing a short black hair.

The larva after the fifth molt is about 1$\frac{1}{2}$ inches in length and the superior spines on segment 2 have fascicular tawny, black tipped spinules, like those of the two dorsal rows, encircling their base. On segments 3 to 11 the lateral row of spines have similar fascicular spines bordering the upper half of their base, as have also the two ante-superior spines of segment 12 at their anterior basal half.

The full grown larva [pl. 17, fig. 8] measures from 1$\frac{3}{4}$ to 2$\frac{1}{2}$ inches in length. The head is red, round and bears a few short brown hairs. The cervical shield is glossy and bordered anteriorally with four of the eight spines with which the first segment is armed. The body tapers moderately to the extremities, is fuscous and sometimes black, and is sprinkled with numerous whitish ovoid spots, each bearing a short fuscous hair. The two superior rows of spines on segments 3 to 10 inclusive are fascicular, spreading over the anterior half of the segment, 30 to 40 in each fascicle, cylindric, tawny colored, tapering near their apex to an acute black spine. The spines of the lateral row, the substigmatal and the ventral are twice the length of the superior spines, of a glossy black color and tapering trunk, with about 12 lateral cylindric branches of nearly equal length. The spiracles are red, the anal plate a deep red, and with pitted surface and short hairs, the legs are glossy black with black hairs. The prolegs are red, with black hairs. There is a median line of brown red spots on the middle of each of segments 5 to 11.

Distribution. This species, as stated by Dr Lintner, is known to occur from Maine to Georgia and it has been reported from Indiana, Illinois, Missouri, and Iowa.

Natural enemies. The caterpillar is well protected with spines but these do not suffice to secure immunity from natural enemies. Dr Lintner states that eight out of 30 individuals he reared were parasitized by a small Ichneumon fly which proved to be Limneria fugitiva Say. He observed that this species spins a cocoon which was found under the elevated central portion of its victim's body, which was clasping a stem by its two extremities. 25 specimens of an undetermined species of Microgaster were also reared from the larvae of this insect. Dr Lintner states that their small white elongate, oval cocoons were spun on the outside of the larva and that after a few days the imagoes appeared. The same species was probably bred by the writer in 1902.

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Hickory tussock moth

Halisidota caryae Harris

Snow white, black dotted, black tufted caterpillars occur in July, August and September, on the tender leaves of hickory and other trees.

This caterpillar is rather common in New York State, and is a somewhat general feeder, though it shows a decided preference for walnut, butternut, and sumac, and is said to be common on elm, ash and linden. Dr Fitch states that he has seen clusters of this caterpillar on the larch and tamarack. It is occasionally present in such large numbers as to cause considerable injury to forest trees in limited localities.

Description. The full grown larva has been described by Dr Harris as follows:

> White, covered with white hairs in short spreading tufts, a row of eight black tufts along the back; two long, black, pencil-like tufts on the fourth and tenth segments; four white on the second and third, two on the 11th and 12th. Head, prothoracic legs and surface of the body are covered with minute black tubercles and a transverse black line between each segment.

The cocoon is oval, ash gray.

The pupa is short, thick and rather blunt, not rounded at the hinder end and not downy, and the moth emerges during the month of June.

The adult insect has a wing spread from a little over 1½ inches to about 2 inches. It has light brown forewings which are irregularly spotted with silvery white and with the veins indicated by darker lines of color. The thorax is a light brown with dark brown at the base of the patagia, and the abdomen is a darker brown. The male may be recognized by its smaller size and the more pectinate antennae.

Life history. The life history of this species has been given by Dr Harris substantially as follows.

> The caterpillars when young, feed in company on the leaves and when not engaged in eating bend down the head and bring over it the long hairs on the forepart of the body. They are 1½ inches long and when full grown, in the latter part of September, forsake the tree, and secrete themselves under stones or in crevices of walls, spinning oval, thin hairy cocoons.

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Birch leaf skeletonizer

Bucculatrix canadensisella Chamb.

Leaves of white birches are sometimes skeletonized by a small pale green caterpillar. The foliage turns brown the latter part of the summer, and the small brownish yellow ribbed cocoons serve to identify the depredator.

This species was exceedingly abundant in New York State in 1901, and skeletonized the foliage of white birch over large areas. It was so prevalent in the vicinity of Albany, that parties desirous of collecting the leaves for medicinal purposes experienced great difficulty in finding uninjured ones. A similar condition obtained over a considerable portion of Massachusetts. This attack is by no means unprecedented, though it is of more than usual interest on account of the large territory involved. This species was reported to Dr Lintner as very prevalent about Scottsville, Monroe co. in 1886, and in 1891 it seriously injured birches about Ausable Forks N. Y. Dr James Fletcher, entomologist of the Central Experimental Farms, Ottawa Can., stated in 1892, that for the previous three years birches of all kinds in the vicinity of Ottawa had been severely damaged by this insect. Dr Packard calls attention to the general occurrence of this species in Providence R. I., and in adjoining portions of Massachusetts, during the same year.

Description. The delicate little moth has been described by Dr Fletcher as follows.

> Moth small, wings expanding 3/8 of an inch. General color, bright brown, the wings crossed with silvery white bars, three of these run from the outer edge about half way across the wings obliquely towards the apex, and there two shorter subtriangular blotches on the inner margin of each forewing. These latter, when the wings are closed, form two white dorsal saddles, the anterior of which is slightly the larger, and is followed closely by a tuft of raised black scales. At the extremities of the forewings are also several raised black scales, a few of which are separated into an apical spot by an irregular narrow white band. The cilia of the fringes are pale brown. Head white; frontal tuft dark brown in the center; antennae brown, slender, about 1/8 of an inch long. Thorax brown with margins including the bases of the forewings, white. Leg and body pale fuscous, silvery.

The full grown caterpillars measure less than 1/4 inch long, are very slender in form and taper considerably at each extremity. Deep incisions divide the body into well marked, rounded segments. The head is long, slightly bilobed, and of a pale brown color, body light green or yellowish green and bears short hairs on small tubercles. The caterpillar walks slowly, and when disturbed, drops from the leaf and suspends itself by a thread. The molting cocoon has been described by Dr Packard as being about 1/12 inch in diameter, and of white silk. The caterpillar is curled up within.

The yellowish brown cocoon is about 1/8 inch long, with a number of well marked ridges and is attached to any convenient object, such as bark and leaves.

Life history and habits. Little is known concerning the life history and habits of this insect. The eggs of the moth and the mining operations of the larvae have not been observed. The larvae occur the latter part of August or in early September, feeding on the soft parenchyma of the leaf and skeletonizing it thoroughly. At this time, small oval whitish, circular cocoons may be observed here and there on the leaves. These are spun as shelters during a molt. The true cocoons are interesting, brownish yellow, ribbed structures about 1/5 inch in length. These latter may be so abundant as to give color to portions of infested leaves. They are spun during the latter part of September, and the insect passes the winter within.

Distribution. This insect has been recorded from Canada, New England States, New York, and as stated by Dr Lintner, it will undoubtedly be found to have a wide distribution.

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Cottonwood leaf beetle

Melasoma scripta Fabr.

Yellowish beetles, about 1/2 inch in length, variably marked with elongated black spots or blackish grubs about 3/8 inch in length, frequently defoliate willows and poplars, specially in the Western States.

This insect is a well known pest of willow, cottonwood and poplar in the Western States, where it occasions very serious injury at times, specially to young trees. This beetle also occurs in the eastern United States, though it is rarely credited with causing much damage.

Injuring European willows. This species has proved a very serious enemy of the European osier or basket willow, grown in Onondaga, Cayuga, Seneca and adjoining counties, where many are raised for basket purposes. The small village of Liverpool, Onondaga co., depends almost entirely on the basket industry for its existence. Willows are grown there in large quantities, most of the inhabitants are basket makers, and nearly all the members of each family have a part in transforming the willow shoots into finished baskets. The extent of this industry is further evidenced by the fact that over 3000 tons of willows were grown about this village in one year.

Early injuries in New York State. This pest was known as early as 1875, and according to Dr Lintner, 57 acres of willows were destroyed in a swamp in Clay, Onondaga co. This discouraged the growers and for a time, fewer willows were raised. Dr Lintner's attention was next called to the insect by a gentleman who collected some of the beetles in 1887, and from that time up to 1894, it had increased in numbers steadily, and in the latter year caused so much injury as to attract general attention. The ravages of this insect in 1894 were serious enough to reduce the yield by 1000 tons. One grower raised 65 tons in 1894, and was able to secure only 25 the following year. Many fields were abandoned at this time and ploughed up and others were cut only in hopes that a better yield would be secured another season. The insect has been more or less abundant from 1895 to the present, 1902, and has been prevented from inflicting serious loss only by active measures.

Life history and habits. The beetles appear in the early spring with the development of the leaves and begin feeding at once. The most serious damage is done at this time, since they show a decided preference for the tender shoots, and by eating them make the willows branch very early, thus rendering them nearly useless for market purposes. After feeding for a time, oviposition occurs, and the yellowish or reddish eggs are placed on end side by side in clusters on the under surface of the leaf. The nearly black grubs hatch from the eggs and feed for a short time in company on the underside of the leaves, then separate more or less. The young grubs skeletonize the under surface of the foliage, and after increasing in size, eat out ragged holes. The grubs when alarmed, exude small drops of a milky white fluid which can be withdrawn at the pleasure of the insect. This process of expulsion and retraction may easily be observed by alternately alarming the grubs and allowing them to remain quiet. They also have a peculiar habit of elevating the abdomen and distending the anal proleg when alarmed. The exudation above described and the threatening movements are probably defensive means against native enemies. Pupation occurs in the partly cast larval skin which is firmly attached to the leaves by the prolegs. The pupae are known to growers as "hangers," and the adult beetles are called "hard shells." Professor Snow states that 15 days are required in August for this insect to pass through its immature stages, thus indicating that in the West, five broods may occur, though most writers credit the species with only three or four. There are said to be three annual generations of this insect in New York State, and it is very probable that with the advance of the season, there is more or less overlapping of the broods. July 23, 1902, it was possible to find all the stages of the insect. There were few eggs, more recently hatched grubs, many nearly full grown larvae, some pupae, and a few beetles. Adults, pupae and older grubs belonged to the second generation and the eggs and newly hatched larvae to the third. Most of the insects are said to disappear from the willows about Aug. 1.

Food plants. This species, according to Dr Riley, has long been known to feed on the leaves of different species of willows, and he states that it is never abundant or injurious on these trees. He adds that it also occurs on several species of Populus, and that its great liking for cottonwood appears to be a recent development. The species of willow suffering most severely from this insect in New York State, is the osier or basket willow of Europe, Salix viminalis. A German willow is also grown to a limited extent. This is a more vigorous plant, produces a larger yield, and is not so subject to insect attacks. It has a smaller market value as it is adapted only for the heavier bottoms of baskets.

Description. The adult beetle is quite variable in its markings. The black thorax is bordered with yellow, and the yellowish or yellow green wing covers are marked with three more or less interrupted lines of black spots. These markings are quite variable in their size and extent. The full grown larva or grub is about 3/8 inch in length, yellowish white, with black thoracic legs, and lighter colored prolegs. There are two rows of tubercles laterally, and four dorsally. The outer ones are glandular, and exude a pungent liquid referred to above. The eggs are about 1/40 inch in length, are deposited side by side in clusters of 10 to over 100. They vary in color from a light to a dark orange, and some have been observed of a yellowish white color. See plate 16, figures 14–20 for illustrations of the insect in its various stages and its work.

Distribution. This species is common in many of the Western States and ranges as far south as Louisiana. It has been recorded from Pennsylvania, is present, though not common, on native willows in New York State, according to Dr Lintner, and is common throughout New Jersey on willows and poplars, as recorded by Dr J. B. Smith. It probably occurs on willows and poplars throughout most of the northern United States.

Natural enemies. This species is subject to attacks by several natural enemies. Dr Riley observed adults of Megilla maculata DeG. feeding on the larvae and pupae of this pest. Prof. Conway McMillan states that besides Ichneumon and Chalcid flies, he has observed some predatory insects attacking this species, chief of these being the ladybugs. He adds that tiger beetles and ground beetles both feed on this insect, and that he observed a reddish yellow mite clinging to the under surface of the abdomen of the beetles.

Remedial measures. Spraying with arsenical poisons has proved somewhat effective in controlling this species, and some experimental work conducted by Professor Lowe has shown that fairly satisfactory results could be obtained by the use of these compounds. The smooth surface of the willows mars the efficiency of this application because the poisoned liquid has a tendency to roll from the foliage and collect in drops. The habits of the beetles and grubs of feeding on the under surface to a great extent, makes it difficult to put the poison where they must eat it or go hungry. In all probability, a heavy application of arsenate of lead very early in the season, would give the best results. Despite the fact that spraying is cheaper than collecting the beetles, the willow growers have come to depend largely on the latter method of preventing injury. Several ingenious devices for the collection of these insects by hand or horse power, have been constructed. They are known as "bug catchers" to the willow growers, and consist essentially of a wooden trough about 20 inches broad and 4 feet long, on runners and with the sides and ends 8 inches high. Plough or other handles are fastened to the posterior end of the machine, and two diverging arms extend forward and outward at acute angles. These arms are designed to catch the tops of the willows, and bend them over the trough, the bottom of which is water-tight and contains kerosene and water. The arms for bending the willows over can be adjusted to various hights so as to accommodate willows at all stages of growth. The splashing of oil and water is prevented by several transverse and longitudinal partitions in the bottom of the bug catcher. The hand machine is pushed over the field and the tips of the willows are caught by the diverging arms, bent and the agitation shakes the insect off. The hand device is more efficient than that drawn by a horse, simply because the animal precedes the machine and frightens the insects so that many fall before the bug catcher can be brought under the willows. The former is difficult to operate and is employed only on smaller patches. It would seem possible to construct one considerably lighter than either of the forms described, and in that event the larger and improved apparatus might be operated by hand with comparative ease.

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Yellow spotted willow slug

Pteronus ventralis Say

Greenish black sawfly larvae about $\frac{6}{10}$ inch long and with heart-shaped, yellowish spots on each side, defoliate willow and poplar.

This species is considered one of the worst enemies of basket willows, particularly in the South because of its producing several generations annually, and even in the North Dr Harris has recorded two broods as occurring in Massachusetts. All kinds of willow with the exception perhaps of the weeping willow and species developing into tall trees are injured by these slugs according to Dr Howard. The species and varieties of white willow appear to be preferred, and young poplars growing in proximity to these trees are also damaged, though their older and tougher leaves escape attack. The greatest injury is inflicted on young growth and as a consequence the species may be controlled with arsenical poisons. One of the serious features of injury by this insect is that the willow, after defoliation, produces leaves on side shoots, thus destroying the commercial value of the product for basket purposes, since the shoots should be of nearly uniform size throughout their length.

Description. The early stages of this insect have been described by Dr Dyar as follows:

> Eggs [see *Insect Life*, 1 : 36]. In large clusters of flat, semicircular saw-cuts under the lower epidermis, 1 x 2 mm in size.
>
> 1st stage. Head round, shining black; width .55 mm. Thoracic feet long, spreading, black except at the joints; segments indistinctly 4-annulate, abdominal feet small, on joints 6–11, 13. Body slightly shining, blackish green, subtranslucent; anal prongs concolorous.
>
> 2d stage. As before. Head .75 mm wide. Body smooth, greenish black, anal prongs black.
>
> 3d stage. Head shining greenish black; width 1 mm; eyes and jaws black. Body scarcely annulate, smooth, shining, obscure blackish olive,

anal fork black tipped. Thoracic feet blackish, marked with black. Body unicolorous, immaculate, or the orange spots of the next stage partly present (another brood).

4th stage. Head shining black, the front with four grooves and two dents above the clypeus; sutures around the mouth brown; width 1.4 mm. Thoracic feet large, pale olive, marked with black; abdominal ones small, on joints 6–11, 13, pale green. Body smooth, irregularly 5-annulate, the creases like slight folds; shining blackish, olivaceous, with a series of lateral pale orange spots, distinct only centrally. The spots are above the subventral fold on annulates 2 and 3.

Larvae vary in shade, some are blacker than others, and the orange spots vary in distinctness. The larvae scratch the leaf with their anal prongs and make a rasping sound.

5th stage. Width of head 1.4–1.6 mm. As before, slaty black, except the feet; lateral orange patches on joints 3–12; the two median annulates have somewhat corneous, dorsal, transverse areas, shining, but concolorous with body. Feet all pale watery. Two days after molting the larvae began to turn shining and livid and with a pale dorsal streak anteriorly and entered the ground to spin their cocoons.

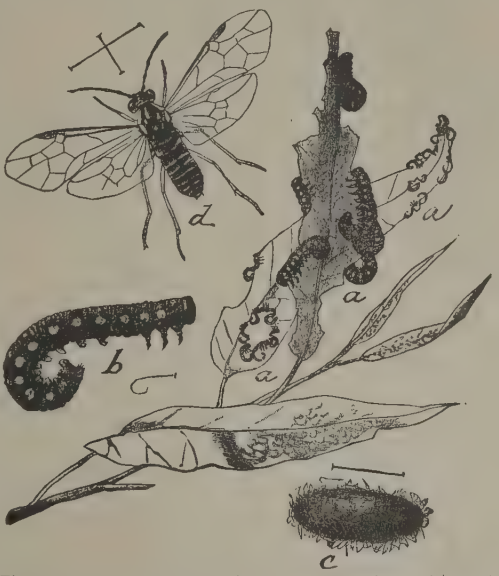

Fig. 62 Pteronus ventralis Say. *a*=larva in feeding position; *b*=larva much enlarged; *c*=cocoon, enlarged; *d*=adult, enlarged. (After Howard, Insect Life, 1888, 1:33)

The adult insect is brownish, black, marked with yellowish white and measures about ⅓ inch in length.

Life history. The first indications of the presence of these slugs on willow, according to Dr Howard, is seen in peculiar blisterlike swellings on the upper surface of the foliage, which sometimes give it a wavy or crumpled appearance. Investigation shows that these swellings are occasioned by the presence of oval, whitish eggs partially inserted in the under surface of the leaf substance. Black spots and streaks appear about the time hatching begins, four to eight days after oviposition, the effect of numerous wounds made in the leaves. The young slugs commence to gnaw small holes as soon as they hatch, those on one leaf usually feeding in close proximity to each other, though they are hardly gregarious. The entire leaf is devoured and the plant soon denuded, leaving only the thicker midribs untouched. No effort is made toward concealment and they can be easily distinguished by their black color and filthy moist excrement. Their peculiar curved position is very characteristic of the group, the posterior segments usually being turned so that they extend forward and not infrequently under a portion of the leaf on which the slug rests. The larva is full grown in from 10 days to three weeks, at which time it descends to the ground and forms a shining dark brown cocoon, apparently composed of a gluelike material. It changes within this retreat to a yellow pupa, and in the course of a week the winged sawfly appears. Eggs are deposited in the District of Columbia from May till the middle of October. This species has been recorded by Dr Packard, as feeding on wild cherry foliage.

Natural enemies. The eggs, according to Dr Howard, are frequently destroyed by a small calcid, Trichogramma, which becomes very numerous when the second brood of females is ovipositing. An ichneumon fly, Ichneumon subcyaneus Cress., has also been reared from this species, and the wheel bug, Prionidus cristatus Linn., is a very efficient enemy of this species in the Southern States.

Remedial measures. This species should be easily controlled by the application of an arsenical poison, preferably arsenate of lead, wherever it is abundant enough to warrant the expense.

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Locust leaf miner

Odontota dorsalis Thunb.

Blisterlike spots or eroded skeletonized areas on honey locust leaves, may be due to the work of the larvae and adults of this insect.

Dr Fitch describes the work of this leaf miner in his 5th report, briefly characterizes the larva, and states that he has never met with it in the eastern section of New York. This insect was also brought to the attention of Dr Lintner at various times, though he never found it in his extensive collections in Albany and Schoharie counties. It is very abundant, however, on Long Island and has been met with by the writer in Chautauqua county, where its work was very common in and about Westfield Aug. 15, 1902.

Injuries. This insect is occasionally so abundant that a large proportion of the foliage on the honey locust is ruined. The larvae form large blisterlike spots under the lower epidermis. The adult beetles feed on the under surface of the leaves, eating away the more delicate portion between the larger veins [pl. 45, fig. 2]. Dr H. G. Dyar, writing to Dr Lintner Aug. 31, 1896, stated that this insect was so abundant at Yaphank L. I., as to injure the trees very seriously, and cause a considerable proportion of the foliage to drop. Mr Chittenden records an instance where this species was exceedingly destructive in Fairfax county, W. Va., where all the locust trees over an area of several square miles were apparently dead, looking as though a fire had swept over the country. On one tract of 300 acres, on which were many locusts, not a tree could be found, either young or old, that was not in bad condition.

Description. The adult beetle is about ¼ inch long, with the head, appendages and under surface and a median triangular area, widening posteriorly on the wing covers, coal-black, the remainder of the wings and the dorsum of the thorax are an orange red. The thorax is irregularly and deeply punctured and the wing covers strongly ridged and ornamented with deep, nearly confluent, thickly set rows of punctures.

The full grown larva is a trifle over ¼ inch long, with the head, thoracic shield, true legs and anal shield, coal black, and the remainder of the body a yellowish white. The segmentation is very distinctly marked and the abdominal segments bear conspicuous lateral tubercles, those on the second to the seventh are tipped with black and bear a black chitinous point. The brown spiracles are circular.

The egg of this species has been described by Mr Chittenden as short, oval in outline and flattened on two sides. He states that its color when freshly laid is milky white and that the shell is extremly thin, pliable, and with a very fine netlike sculpture, visible only with a strong magnifying glass.

Life history. The life history of this beetle in West Virginia, has been given by Dr Hopkins, as follows:

> The adults probably appear in May or June and deposit eggs on the under surface of the leaves. The small grubs hatching therefrom burrow in and feed upon the delicate parenchyma, forming blisters near the edges which usually extend to the midrib. They transform within the blister to the pupa and the beetles soon emerge and feed upon the remaining unaffected leaves.

Mr Chittenden states that the beetle makes its first appearance in the vicinity of Washington soon after the leaves of the locust tree have fully developed, usually about the beginning of May, and from then it may be found continuously throughout the summer till the first half of September, it being quite abundant from the first week of July till nearly the middle of August. He states that the beetles of the first spring generation began to develop July 7 in 1902 and had transformed for the most part by the 12th. He adds that the beetles are usually seen apparently motionless on the surface of the leaves but close inspection will show that they are feeding. Early in the season the adults eat small oblong holes in the leaves, but later the lower half is left intact and the upper portion finely skeletonized. The injury done by the beetles, even when they are very numerous, is trifling when compared with the work of the larvae. Mr Chittenden states that during rainy weather, at night time and while ovipositing the beetles may be met with on the underside of the leaves. He finds that the eggs are deposited by the female at intervals of about two minutes, the act of oviposition itself requiring only a fraction of a second. On the completion of oviposition the beetle makes a sudden movement forward, sweeping the upper side of the egg mass with the tip of her abdomen and covers it with a large quantity of fluid, dirty yellow fecal matter which soon hardens and darkens. He adds that there are never more than five eggs in a mass. Mr Chittenden states that the young larvae invariably break through the eggshell on the underside and begin gnawing through the epidermis of the leaf without leaving the protection of the egg mass. They then proceed to devour the softer parenchyma, thus forming what is known as a tentiform mine. There is but a single entrance to the mine, the later hatching grubs availing themselves of the hole eaten by the earliest individual, therefore from 3 to 5 young grubs usually occur within a mine, which is rapidly enlarged by their united efforts. The mine in one leaf rarely occupies more than ½ or ⅔ of its area, and this means that in from two to four days after hatching the grubs forsake the original retreat, wander along leaf stems to other leaves and begin operations anew. This time each grub works by itself. The injury inflicted by the adults and the larvae, particularly the latter, causes the leaves to turn brown, wither and fall. The writer found mostly deserted mines and very few larvae at Westfield Aug. 15, 1902, indicating that the main portion of the brood had completed its transformations. Apparently there is but one generation in this latitude, specially since Mr Chittenden states that while the insect appears at Washington in May, a month earlier than in Massachusetts, and may be found in all stages throughout the summer till early in August, he has seen no evidence of a second generation being produced.

Food plants. This species prefers the locust. It also has been recorded as attacking the young leaves of red oak, and Dr Hopkins has found it on white oak, beech, birch and hawthorn in West Virginia. Mr Chittenden records the beetle as feeding on red clover, hog peanut and soja beans.

Parasites. Several small Chalcis flies have been reared from this insect. They are as follows: Spilochalcis (Smicra) odontotae Howard, was reared from the pupa. Sympiezus uroplatae Howard feeds externally on the larva within its mine. Trichogramma odontotae Howard, is an egg parasite issuing in July. Derostenus primus Howard was reared from the leaf mine of Odontota. Dr Howard thinks it may be a secondary parasite, preying on either of the first two species.

Natural enemies. In addition to the parasites named above, Mr Chittenden states that at Washington the wheel bug, Prionidus cristatus Linn., is particularly attracted by the presence of this leaf miner and the young of the wheel bug may be frequently observed walking slowly over the leaves till they have found an inhabited mine, when it deliberately thrusts its beak through the epidermis of the leaf into the Odontota larva. The beetles are attacked by this insect when met with and at once lifted in the air on the tip of the bug's proboscis.

Distribution. Dr Horn has given the distribution of this insect as " Middle and Southern States." Dr Packard records it from New England, Middle and Western States and Professor Webster has mentioned serious injuries by it in southern Ohio and the adjacent parts of Kentucky. In addition, Mr Chittenden states that it is known to occur in Massachusetts, Connecticut and Canada, though it does not appear to have ever been taken in Michigan, a State rather thoroughly collected over by Messrs Schwarz and Hubbard. He adds that the insect appears to be rare in Missouri and concludes that its southern range is practically limited by the States of Virginia and Kentucky, while Missouri defines its southwestern distribution.

Remedial measures. This beetle, like some other species, drops to the ground when alarmed and Dr Lintner has expressed the opinion that this habit might be taken advantage of in the case of valued shade trees. The insects could be jarred on a sheet, collected and destroyed. Mr Chittenden states that the beetles are susceptible to arsenical sprays and suggests the use of paris green. In all probability arsenate of lead would be more effective.

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Golden oak scale

Asterolecanium variolosum Ratz.

This circular, convex, bright yellow or golden scale insect, about 1/16 inch in diameter sometimes occurs on oak twigs in very large numbers.

This introduced species has become established in several localities within the State, and on account of its injuries and abundance has been brought to the writer's attention on several occasions. It was received on white oak twigs from Yonkers N. Y., Sep. 16, 1900, at which time many of the branches were literally covered in places with this insect.

Early history. This species was first recognized in this country in 1880 by Professor Comstock, who records it from imported oaks on the Department of Agriculture grounds at Washington D. C. He adds that the species is not a common one in Europe, though it is occasionally quite destructive to individual trees. Dr L. O. Howard, writing of this insect in 1889, states that it occurred at that time on the grounds of the Department of Agriculture at Washington, almost entirely on American oaks. This species was recorded on an old white swamp oak at Elizabeth N. J. in 1891, by Dr J. B. Smith, who states that a small branch was densely covered by the scales of this insect, and that the entire tree was badly infested. This attack was first observed in 1890. This species is characterized by the editor of *Gardening* in 1895, as the greatest enemy of the golden oak and the statement is made that most of these oaks appear infested by this pest. Mr A. S. Fuller in *Gardening* for the same year, states that he observed the species about 1889, and adds that many smaller twigs and branches of infested trees died as the result of attack. The following spring, however, he was unable to find any specimens. Mr Fuller records this scale insect as occurring rather widely on the English oak. This species was first reported from New York State by Professor Lowe who found the insect in 1894 very abundant on oaks at Geneva. He states that the species was present in great numbers and that two trees at the northern end of the row were nearly leafless and apparently dying. They were badly infested with the scales from the highest branches to nearly the base of the trunk, and the next two trees were apparently succumbing to the pest, since most of the lower limbs had not produced leaves and some of the smaller branches were dead. Prof. W. C. Sturgis records the presence of this insect on English oak at New Haven in 1895, and this species was brought to Prof. C. H. Fernald's attention in 1897, when it was found on golden oak at Worcester Mass.

Description. This scale may be easily recognized by its bright yellowish golden color, its circular convex form, and by the deep oval depressions it makes in the twig. It is, as previously stated, about 1/16 inch in diameter. See plate 12, figure 5.

Life history. The young of this insect begin to appear in the latitude of Washington D. C., about the first of May, and at Geneva N. Y., they were first observed May 29, 1895 by Professor Lowe. Professor Sturgis records their appearance in April under laboratory conditions, and states that this is probably at least two weeks earlier than normal. The insect evidently passes the winter in the adult or nearly full grown condition.

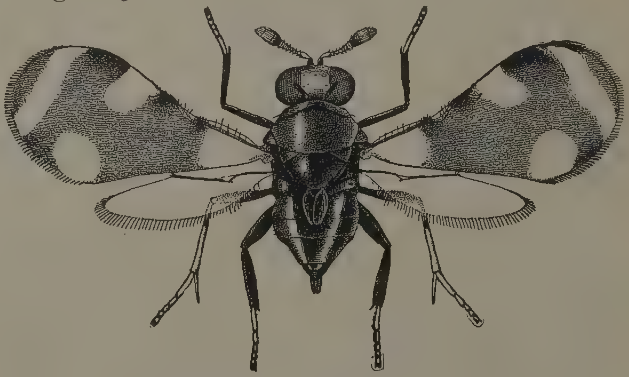

Fig. 63 Habrolepis dalmanni, dorsal view of female. (After Howard, U. S. Dep't Agric. Div. Ent. Bul. 17. 1898)

Natural enemies. Nothing had been recorded concerning the natural enemies of this species in America prior to 1898, when Dr Howard called attention to the very beautiful European Habrolepis dalmanni Westw., an accidental introduction into this country, and states that he received a large series of this parasite from Mr A. H. Kirkland who had reared it from this insect which latter has become common on the oaks throughout the Middlesex Fells. Dr Howard is of the opinion that the parasite was probably brought over with the original importation and that this scale insect has become thoroughly established in that section. This beautiful parasite is illustrated at figure 63.

Mr R. H. Newstead of England states that he has seen the blue tit and the long tailed tit feeding on this and certain other scale insects. It would seem very probable that some of our native birds would feed on this insect to some extent, and it is likely that some of our common predaceous insects may learn to subsist on this pest.

Remedial measures. The experiments of Dr C. L. Marlatt show that the recently hatched young can be killed with a kerosene emulsion prepared according to the standard formula and diluted with 13 parts of water. This application should be made at the time the young are most abundant, which can be easily determined by a little observation about the middle of May or later.

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Hickory gall aphid

Phylloxera caryaecaulis Fitch

Bulletlike, hollow green galls of a leathery texture, occur on hickory shoots in June, turning black the latter part of the month or early in July, and somewhat resemble the black knot of plum.

These peculiar growths on the terminal limbs of hickory are brought to the writer's attention almost annually by the receipt of more or less deformed twigs with inquiries as to the cause of the trouble.

This species was noticed and described by Dr Fitch in his first report. He states that the insect is of frequent occurrence in New York and our observations accord with his. Dr Fitch described the excrescences on the limbs at the time of nut-gathering, as black, ragged, leathery, cup-shaped and as having a marked resemblance to some species of fungi.

Life history. Dr Fitch stated that this species probably winters in the egg and that early in the season females station themselves either on the midvein of one of the leaflets, on the leaf stalk or still further down on the green succulent twigs and cause a profuse flow of sap. It is probable that the insects so irritate adjacent tissue as to cause this abnormal growth and as the gall increases in size, young are brought forth and they in turn draw nourishment from its juicy walls. The galls are globular in shape and range in size from that of a pea to an ounce ball. They are attached to the side of the stem the whole length of their base and often cause a bend or distortion, specially when two or three are contiguous and confluent. The walls of the galls are about $^1/_{10}$ inch thick with a fleshy texture, white on the inside and green on the outside. The inside of the gall at this time is literally covered with minute shiny lice of different ages and sizes and as Dr Fitch aptly states, it resembles the geode of the mineral, the surface of which is lined with a multitude of minute crystals whose sparkling points are everywhere glistening in the light. The dusky cast skins of the lice are also visible in the gall as well as numerous round black grains and smaller globules of honeydew. The black grains are the excrement of a larva, probably that of a weevil which lives within the galls. One would think that insects within such a retreat would be free from insect enemies, but Dr Fitch records meeting with four larvae, probably the young of a Syrphus fly, in one of these galls.

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EXPLANATION OF PLATES[1]

PLATE 1

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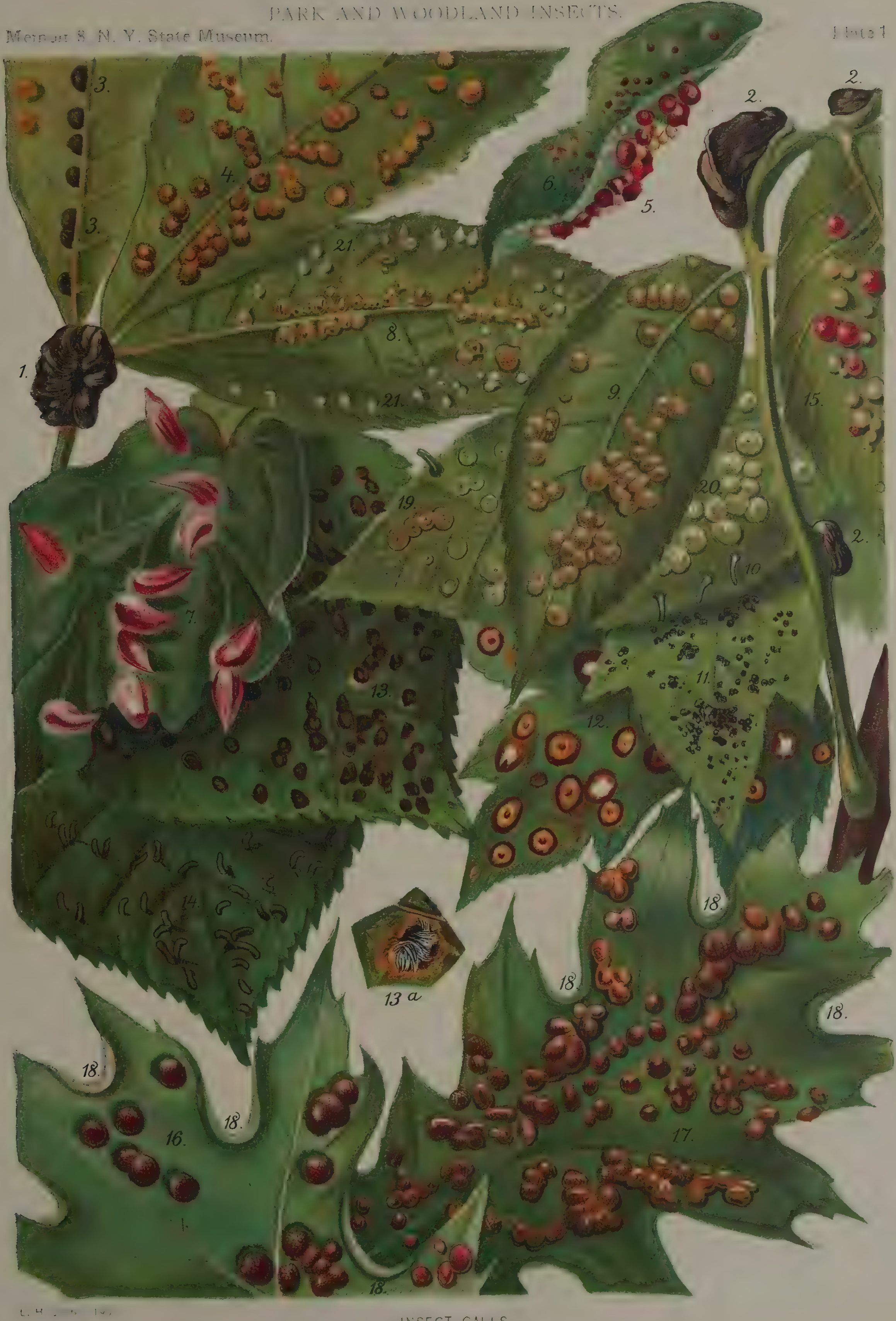
[1] Plates 1–20 executed from nature, under the author's direction, by L. H. Joutel. Plates 2, 3, 4, 7, 8, 17, 19 and 20 reprinted from the 4th, 5th and 7th reports of the N. Y. Forest, Fish and Game Commission, plate 10 lithographed from the original published in the 5th report of the commission.

Insect galls

1 Phylloxera caryaecaulis Fitch gall on hickory leaf stem
2 Side view of same
3 Undetermined black galls along midrib of hickory leaf
4 Cecidomyia holotricha O. S. galls on underside of leaf
5 Undetermined Phylloxera gall on hickory
6 Appearance of same on upper surface of leaf
7 **Witch-hazel cone gall,** Hormaphis hamamelidis Fitch on witch-hazel leaf
8 Diplosis caryae O. S. gall on underside of hickory leaf
9 Cecidomyia persicoides O. S. gall on underside of hickory leaf
10 **Hickory tube gall,** Cecidomyia tubicola O. S. gall on underside of hickory leaf
11 **Bladder maple gall,** Phytoptus quadripes Shimer galls on underside of soft maple
12 Spotted maple leaf galls, Sciara ocellaris O. S.
13 Galls of Cecidomyia verrucicola O. S. on linden
13*a* Opening of linden mite gall on underside of leaf more enlarged
14 **Linden mite gall,** Phytoptus abnormis Garm.
15 Undetermined Phylloxera gall, probably same as shown at 5
16 **Oak pill gall,** Cecidomyia pilulae Walsh galls on underside of oak leaf
17 Galls of the same species on upper side of oak leaf
18 Saclike galls of Cecidomyia erubescens O. S.
19 **Hickory button gall,** Phylloxera foveola Perg., on underside of hickory leaf
20 Undetermined Phylloxera galls on underside of hickory leaf
21 **Hickory seed gall,** Cecidomyia caryaecola O. S. galls on underside of hickory leaf



L. H. [illegible]

INSECT GALLS

PLATE 2

a 335

Sugar maple borer, Plagionotus specious Say

1 Place where egg was laid.

1*a* Another more than normally discolored and showing excrement or borings thrown out by borer

2 Borer or grub in September from egg laid the same season

3 Nearly full grown borer

4 Adult or beetle

5 Hole through which the beetle escaped from the trunk

6 Sawdust or borings packed in burrow

Maple and oak twig pruner, Elaphidion villosum Fabr.

7 Grub or borer in its burrow, a portion of the twig being cut away to show its work.

7*a* Small twig with only a thin shell of bark, the wood being nearly all eaten

8 Pupa in burrow. The base of both twigs represented has been nearly eaten off by the larva

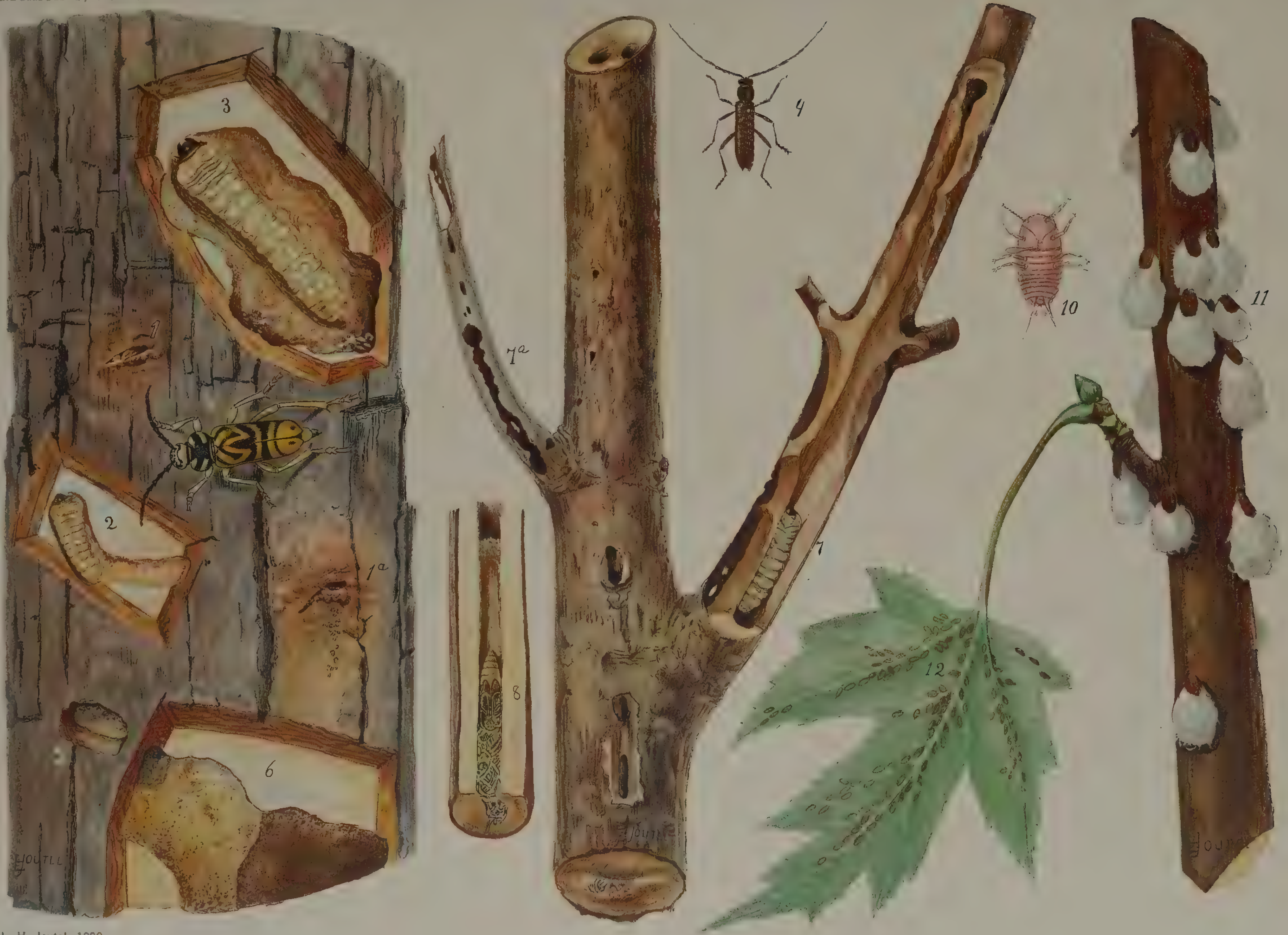
9 Adult or beetle

Cottony maple scale, Pulvinaria innumerabilis Rathv.

10 Active or recently hatched young

11 Adult females, many eggs can be found in the woolly masses

12 Leaf with many young scales on its underside



L. H. Joutel, 1900.

MAPLE BORERS AND COTTONY MAPLE SCALE

PLATE 3

a 337

Elm borer, Saperda tridentata Oliv.

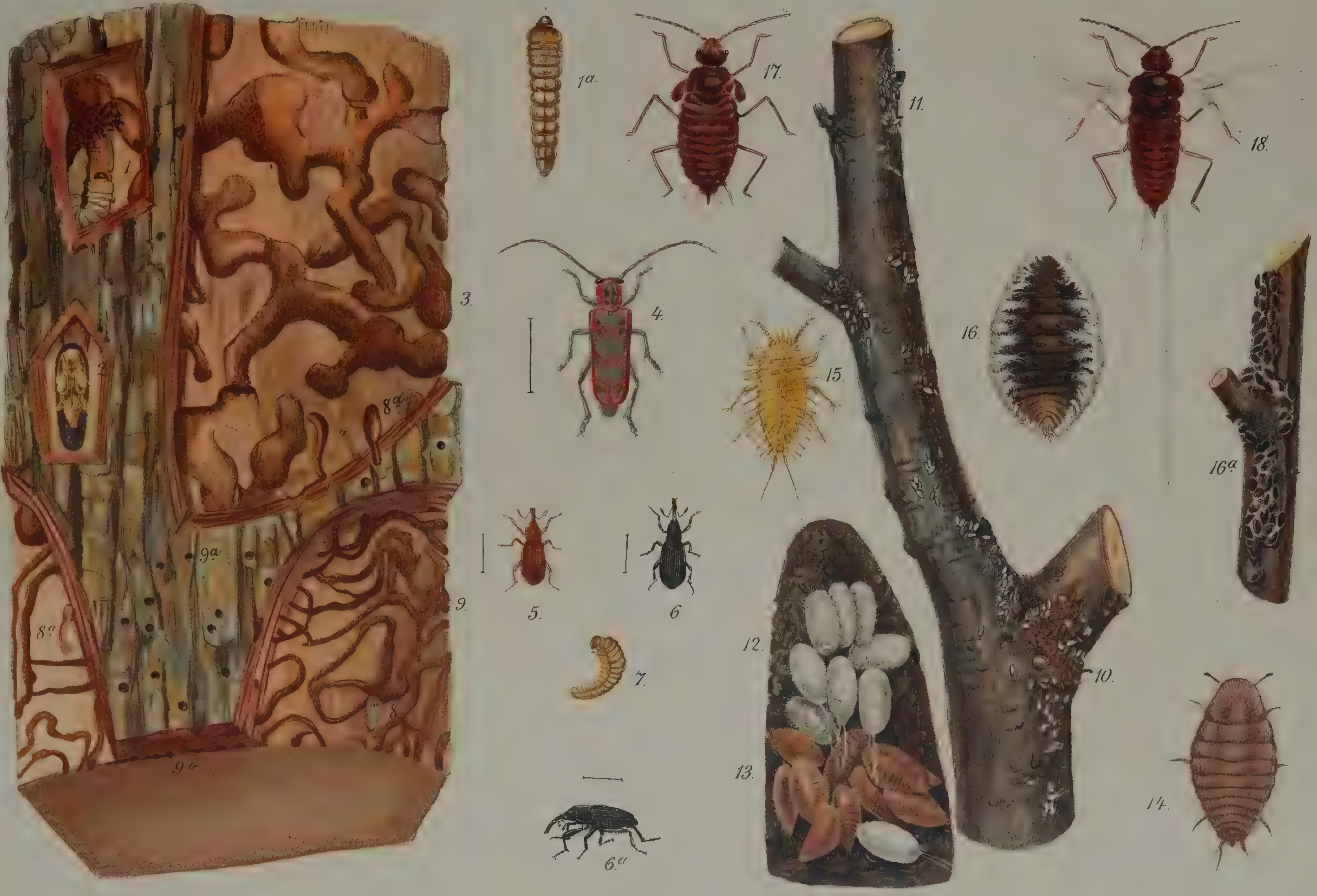
1 Larva or grub within its burrow just under the bark, natural size
1*a* Larva or grub extended, natural size
2 Pupa within its cell just under the bark, natural size
3 Burrows of the grub as exposed after removal of the bark, natural size
4 Adult beetle, line beside it shows its natural size

Elm snout beetles, Magdalis sp.

5 Adult of Magdalis armicollis Say, line beside it represents its natural size
6 Adult of Magdalis barbita Say, line beside it represents its natural size
6*a* Side view of same
7 Larva of same, side view, natural size
8 Pupa of same within its oval cell just beneath the bark, natural size
8*a* Empty pupal cell of same, natural size
9 Burrows of Magdalis barbita Say as exposed after removal of the bark, natural size
9*a* Holes in the bark through which the beetles escape, natural size
9*b* Showing how bark is loosened by the burrows of this insect, natural size

Elm bark louse, Gossyparia spuria Mod.

10 Group of partly grown bark lice as they appear in early spring, natural size
11 Group of male cocoons, natural size
12 Group of male cocoons, much enlarged
13 Group of virgin females, much enlarged
14 A female, much more enlarged
15 Recently hatched young, very much enlarged
16 Mature female, much enlarged
16*a* Matured females on a twig, enlarged
17 Pseudimago or wingless male, much enlarged
18 Winged male, much enlarged, note also the long, white, anal filaments



L. H. Joutel, 1900.

ELM BORERS AND ELM BARK LOUSE

PLATE 4

a 339

Leopard moth, Zeuzera pyrina Fabr.

1 Empty pupal case from which female moth has emerged

2 Female moth at rest on the bark

3 Male moth with wings expanded

4 Nearly full grown caterpillar, probably a female

5 Male pupa in its burrow

6, 6*a* Exit holes covered by a loose piece of bark which the pupa will push off as it partly emerges

7 Hole made for the pushing out of excrement and then closed by a silk web

8 Same as above, but in use with particles of excrement dangling by silken threads

9 Work of caterpillar a preceding season

10 Work of caterpillar the present season

11 Young twig eaten by larva, point of entrance at *a*

Maple borer, Sesia acerni Clem.

12 Hole from which pupal case has fallen

13 Bark nearly eaten through ready for the pupa to push out

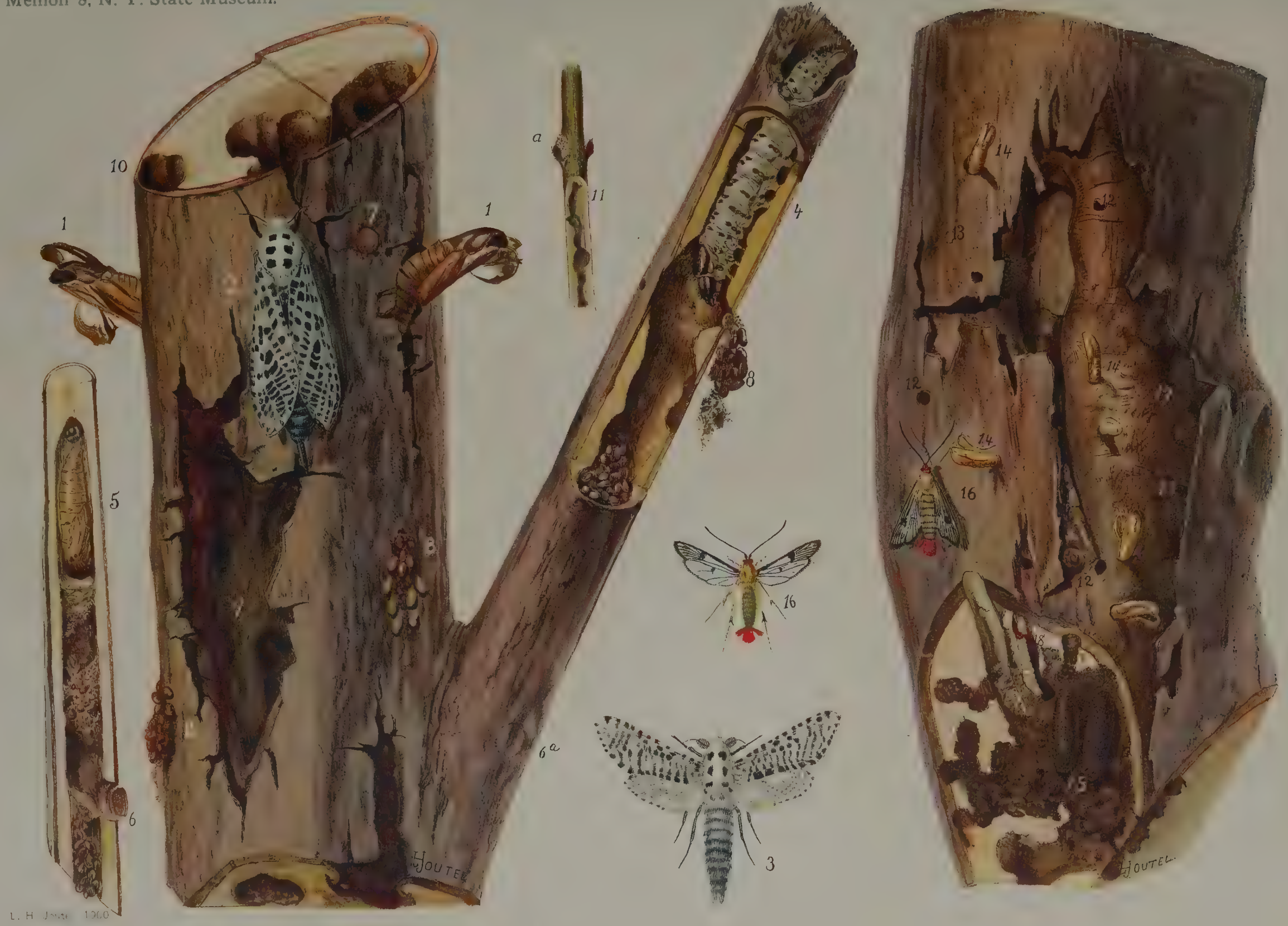
14 Empty pupal skin

15 Two cocoons as spun

16 Moths expanded and at rest

17 Excrement of caterpillars

18 Caterpillar in its burrow



LEOPARD MOTH AND MAPLE BORER

PLATE 5

a 341

Locust borer, Cyllene robiniae Forst.

1 Pupa in its cell

2 Plug of wood fibers closing the free end of the pupal cell

3 Beetle at rest

10 Eggs deposited in crevices of the bark

Carpenter worm, Prionoxystus robiniae Peck

4 Female at rest on the bark

4*a* Dark colored eggs deposited loosely in the crevices

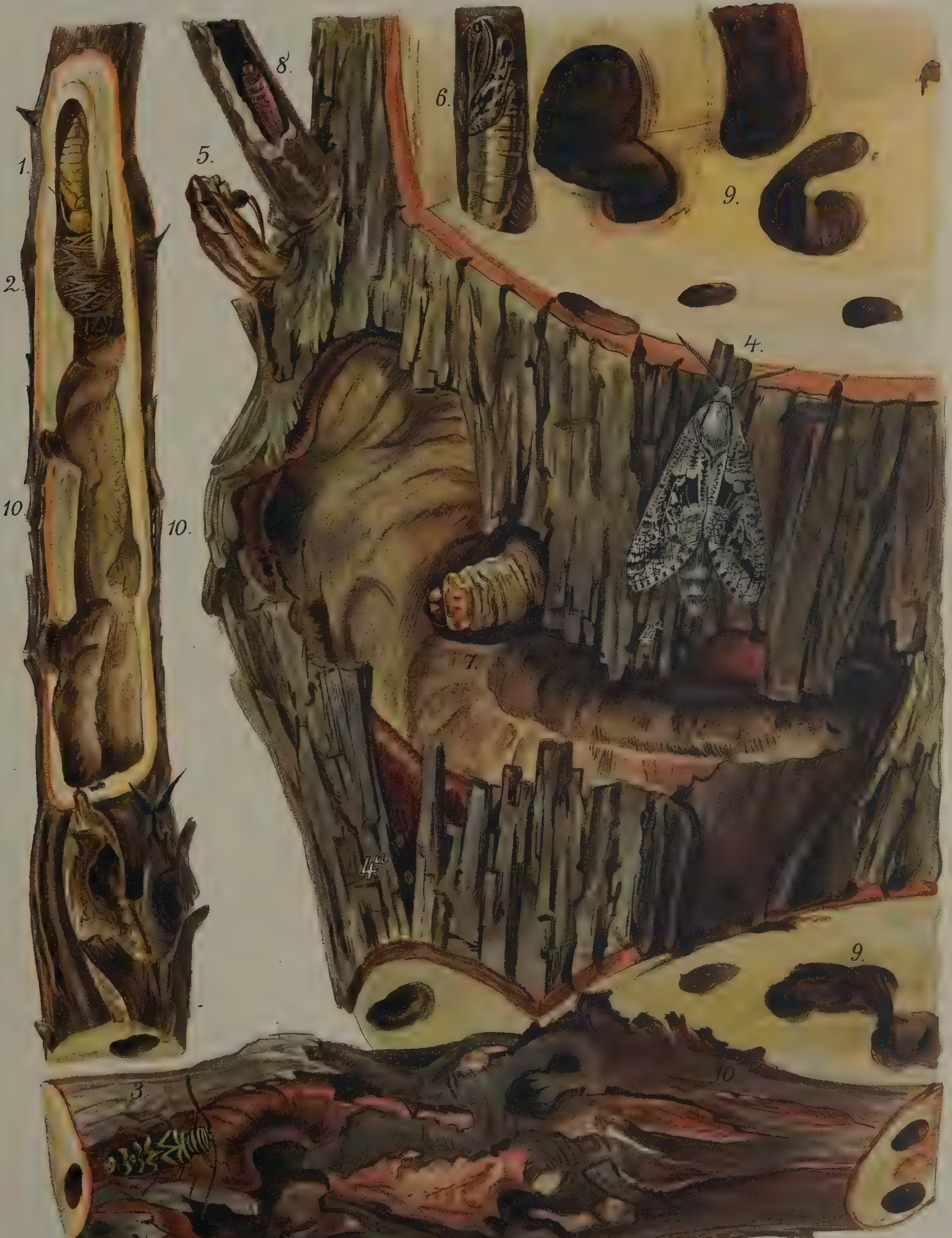
5 Pupal case partially projecting from the burrow

6 Pupa within its cell

7 Full grown larva with its head protruding from a burrow

8 Young larva at work in a small twig

9 Irregular borings of the full grown caterpillars



L. H. Joutel, 1905.

LOCUST BORERS

PLATE 6
a 343

Poplar borer, Saperda calcarata Say

A Piece of poplar showing work of this insect
1 Work of young larva
2 Adult
3 Orifice in bark through which borings are expelled
4 Gallery leading to orifice shown at 3
5 Peculiar excelsiorlike borings made by larva
6 Pupa in its chamber with one end stopped by excelsiorlike borings
26 Full grown larva

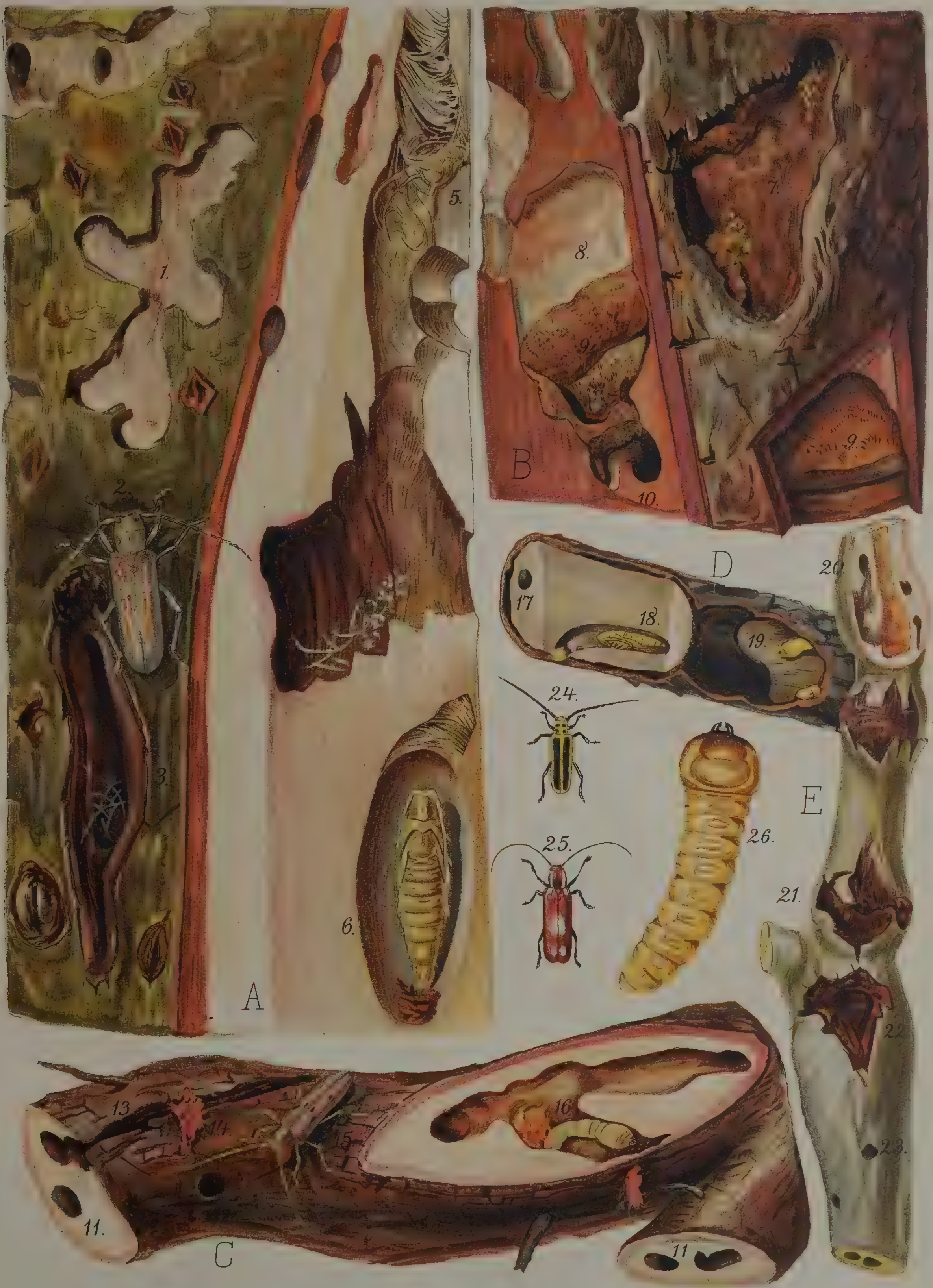
Linden borer, Saperda vestita Say

B Portion of base of linden showing the work of this species
7 Expanded gallery under bark made by larva
8 Gallery in wood extending under bark to 7
9 Sawdust packed in the larval gallery
10 Gallery leading into heart of the tree
C A piece of linden root with portion cut away to show operations of the grub
11 Larval galleries in cross-section
12 Circular exit hole of the beetle
13 Wound made by borer
14 Frass ejected by larva
15 Adult beetle on the bark
16 A portion of the bark cut away showing the borer in its gallery

Woodbine borer, Saperda puncticollis Say

D Piece of woodbine showing work of this species
17 Larval gallery in section
18 Pupa in its chamber showing orifice
19 Larva and its work under the bark
24 Adult beetle

Plate 6



L. H. Joutel, 1905.

POPLAR, WOODBINE AND THORN BORERS

Thorn limb borer, Saperda fayi Bland

E Thorn limb showing workings
20 Section of gall illustrating operations of larva
21 Undeveloped gall due to premature death of inmate
22 Fully developed gall
23 Circular exit of adults
25 Adult beetle

PLATE 7

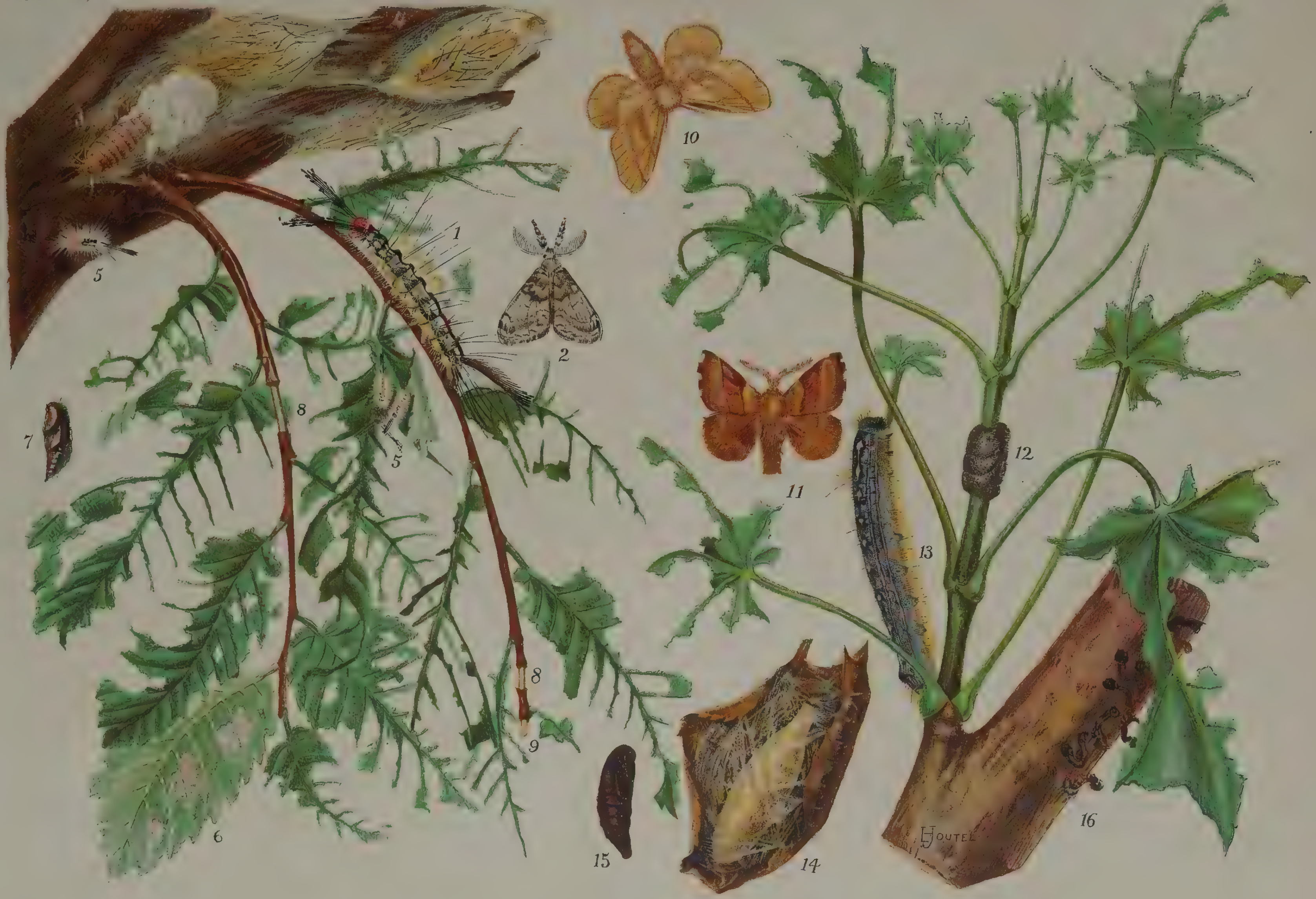
a 347

White marked tussock moth, Hemerocampa leucostigma Abb. & Sm.

1 Side view of full grown caterpillar
2 Male moth at rest
3 Female moth laying eggs on her recently vacated cocoon
4 Several cocoons
5 Cast skins of caterpillars
6 Work of young caterpillars on under surface of leaf
7 Male pupa
8 Branch girdled by caterpillar
9 End of branch broken off at the point where it was girdled

Forest tent caterpillar: maple worm, Malacosoma disstria Hübn.

10 Female moth with wings expanded
11 Male moth with wings expanded
12 Egg belt encircling twig
13 Side view of full grown caterpillar
14 Cocoon in a leaf
15 Pupa
16 Cast skins of caterpillar



L. H. Joutel, 1900,

WHITE MARKED TUSSOCK MOTH AND FOREST TENT CATERPILLAR

PLATE 8

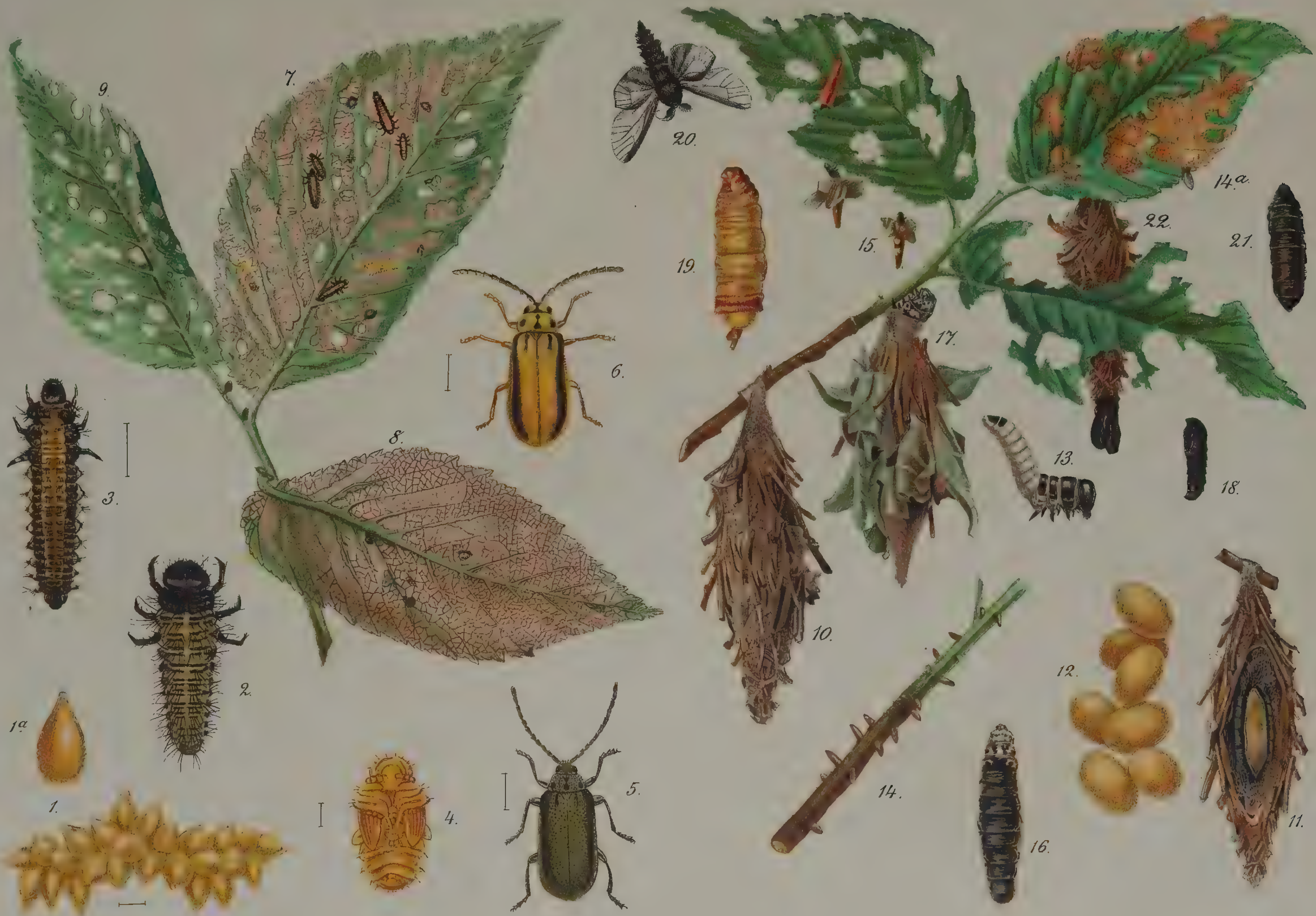
a 349

Elm leaf beetle, Galerucella luteola Müll.

1 Cluster of eggs much enlarged
1*a* Side view of single egg, still more enlarged
2 Dorsal view of recently hatched larva or grub, much enlarged
3 Dorsal view of full grown larva or grub, much enlarged
4 Pupa, much enlarged
5 Overwintered beetle, much enlarged
6 Fresh, brightly colored beetle, much enlarged
7 Under surface of leaf showing eating of larvae or grubs and a few holes eaten by beetles, eggs in clusters, cast larval skins and full grown larvae, natural size
8 Leaf nearly skeletonized by grubs or larvae and on it three cast larval skins, natural size
9 Leaf showing holes eaten by beetles, natural size

Bag or basket worm, Thyridopteryx ephemeraeformis Haw.

10 Bag or larval case as seen in winter, natural size
11 Same as preceding but cut open to show the pupal case and the eggs
12 Several eggs, very greatly enlarged
13 Side view of recently hatched larva, greatly enlarged
14 Cases of young larvae on twig, natural size. Notice that the dark ones are on the dark bark and the light ones on the green bark.
14*a* Leaf eaten by young larvae, natural size
15 Older larvae in their bags which are ornamented with pieces of leaves, one is on the leaf, another hanging from the edge and a third dangling by a thread, natural size
16 Full grown larva removed from its case, natural size
17 Full grown larva walking with its case, natural size
18 Male pupa, natural size
19 Wingless female moth, natural size
20 Male moth with wings spread, natural size



L. H. Joutel, 1900.

ELM LEAF BEETLE AND BAG OR BASKET WORM

21 Female pupa, natural size

22 Bag of male hanging from a leaf and with the empty pupal case protruding from its lower extremity, natural size. The leaf in front of the bag shows the work of half grown larvae.

PLATE 9

a 353

Beautiful hickory borer, Goes pulchra Hald.

1 Adult

2 Exit hole of same in trunk

3 Partially healed wound caused by young larvae

4 Work of same the year after the eggs are laid

5 Characteristic feeding of adult and also of the hickory twig girdler, Oncideres cingulata Say

Twig girdler, Oncideres cingulata Say

6 Adult girdling a branch

7 Girdling operations partly finished

8 Girdling operations of the preceding year

8*a* Characteristic scratchings on the bark in the vicinity of the girdled area

9 A completely girdled twig

10 Punctures at base of branch where eggs are laid

11 An early girdled twig ; a portion of the branch beyond containing the larva has broken off and fallen to the ground

12 Larva in its burrow

Gipsy moth, Porthetria dispar Linn.

13 Male with wings spread

14 Female moth at rest on the bark

15 Characteristic egg masses

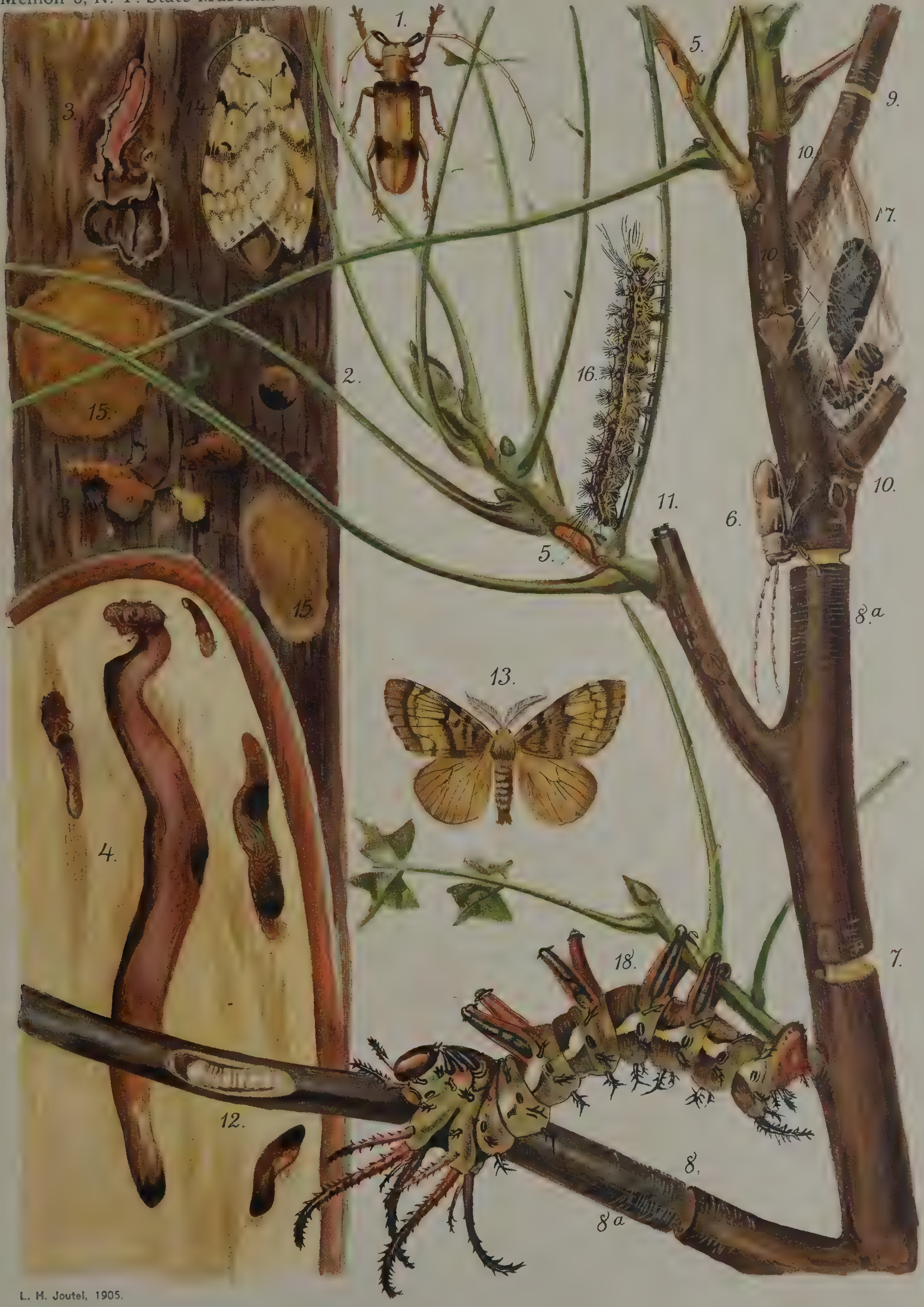
16 Side view of full grown larva

17 Pupa of same and cast larval skin in the characteristic scanty webs

Hickory horned devil, Citheronia regalis Fabr.

18 Side view of partly grown larva

Plate 9



L. H. Joutel, 1905.

GIPSY MOTH AND HICKORY INSECTS

PLATE 10

a 355

Fall web worm, Hyphantria textor Harr.

1 Cluster of eggs, natural size

2 Dorsal views of full and partly grown larvae and also a side view of a full grown caterpillar

3 Pupa, natural size

4 Pupa, more enlarged

5 White form of moth in resting position, natural size

6 Spotted form of moth with wings expanded, natural size

Figures 2, 5 and 6 are on a small web showing within the partly skeletonized, discolored leaves and the frass or excrement of the caterpillars.

Spiny elm caterpillar, Euvanessa antiopa Linn.

7 Cluster of eggs on a leaf stem, natural size

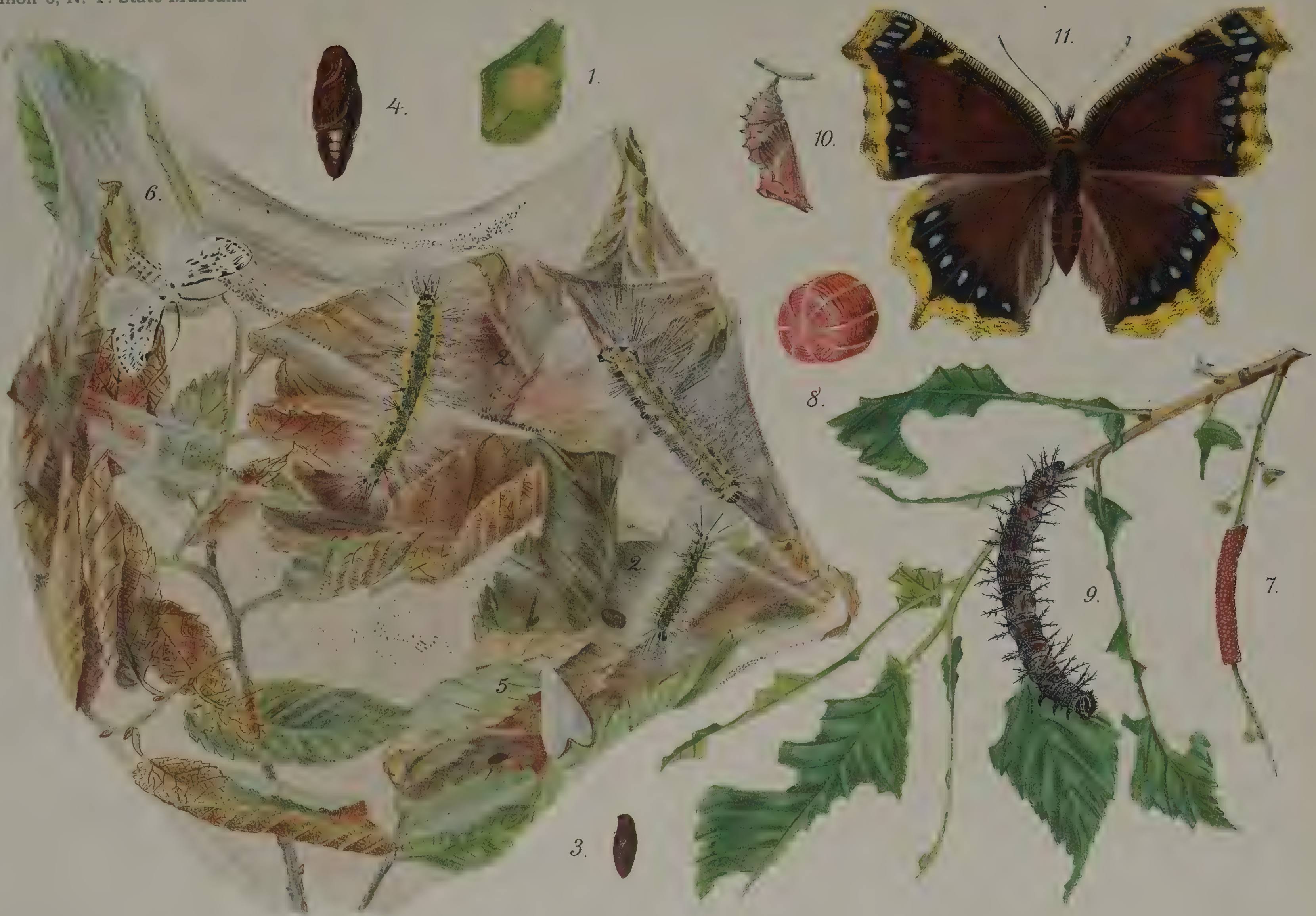
8 One egg, much enlarged

9 Caterpillar feeding, natural size

10 Chrysalis hanging from a leaf stem, natural size

11 Butterfly with wings spread, natural size

The figures of the egg and caterpillar are on a twig of elm representing the characteristic work of the caterpillar.



L. H. Joutel, 1905.

FALL WEB WORM AND SPINY ELM CATERPILLAR

PLATE 11

a 357

Aphids or plant lice

Painted maple aphid, Drepanosiphum acerifolii Thos.

1 Infested leaves of silver maple

2 Adult winged specimen very much enlarged

3 Nearly full grown nymph very much enlarged

4 Younger nymph very much enlarged

Chaitophorus ? aceris Linn.

5 Infested leaves of Norway maple

6 Wingless female very much enlarged

Two-spotted lady beetle, Adalia bipunctata Linn.

7 Larva

8 Pupae

9 Adult

Woolly beech leaf aphid, Phyllaphis fagi Linn.

10 Infested beech leaf

11 Nymph much enlarged

Elm leaf aphid, Callipterus ulmifolii Mon.

12 Infested elm leaf

13 Nymph very much enlarged

14 Winged female very much enlarged

Transverse poplar stem gall, Pemphigus populi-transversus Riley

15 Galls

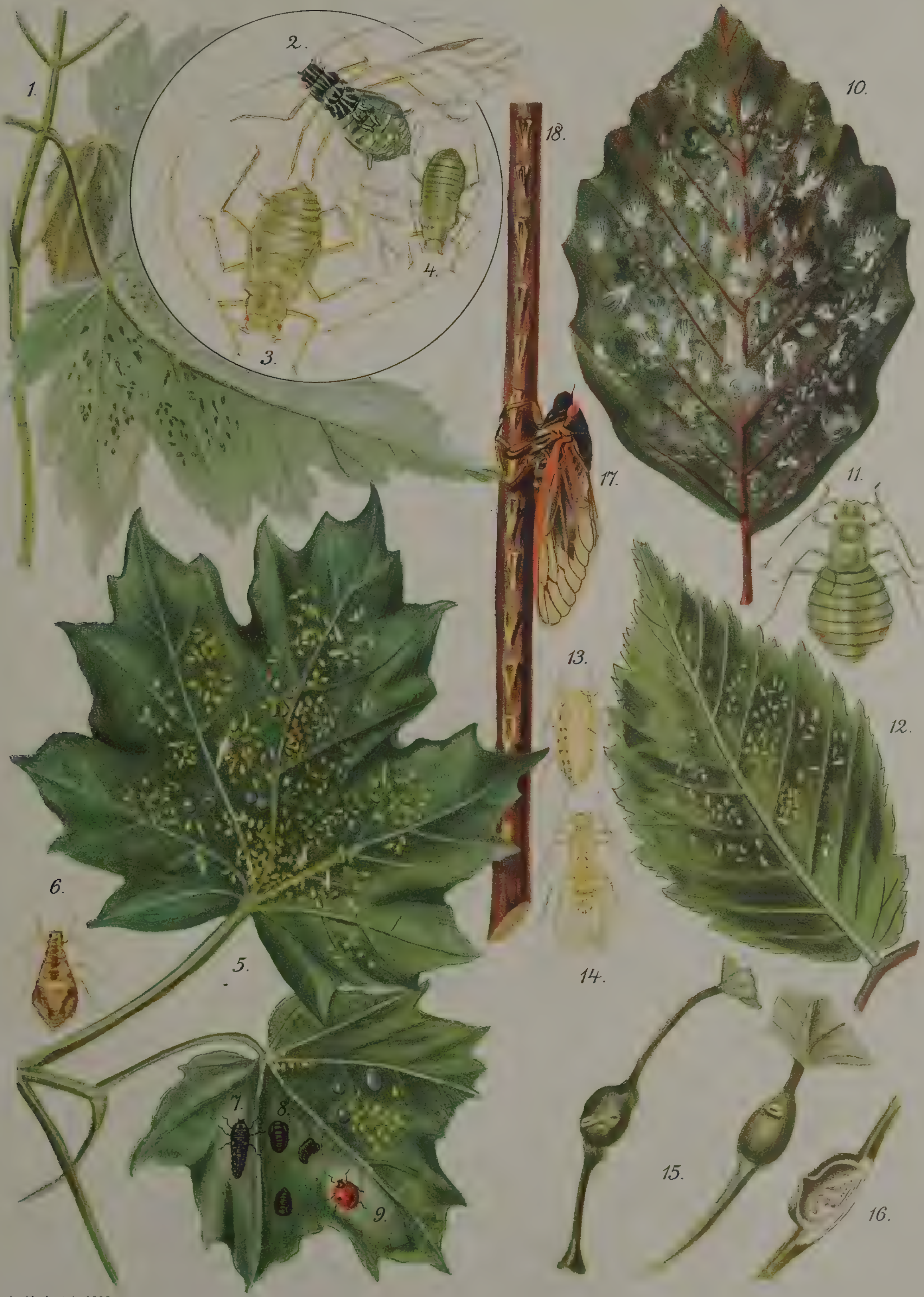
16 Section of one showing plant lice within

Periodical cicada, Tibicen septendecim Linn.

17 Side view of adult

18 Twig showing oviposition scars

Plate 11



L. H. Joutel, 1905.

APHIDS OR PLANT LICE

PLATE 12

a 359

Scale insects

Maple phenacoccus, Phenacoccus acericola King

1 Clusters of male cocoons on sugar maple bark
2 Females and young on underside of leaf

Black-banded lecanium, Eulecanium nigrofasciatum Perg.

3 Badly infested soft maple twigs
4 Young along sides of leaf veins
10 Male very much enlarged
11 Full grown female scales showing characteristic markings much enlarged
12 Young very much enlarged

Golden oak scale, Asterolecanium variolosum Ratz.

5 Infested oak twig

Tuliptree scale, Eulecanium tulipiferae Cook

6 Badly infested tulip branch
8 Recently hatched young very much enlarged
9 Young scales very much enlarged

White flower cricket, Oecanthus sp.

7 Oviposition scars

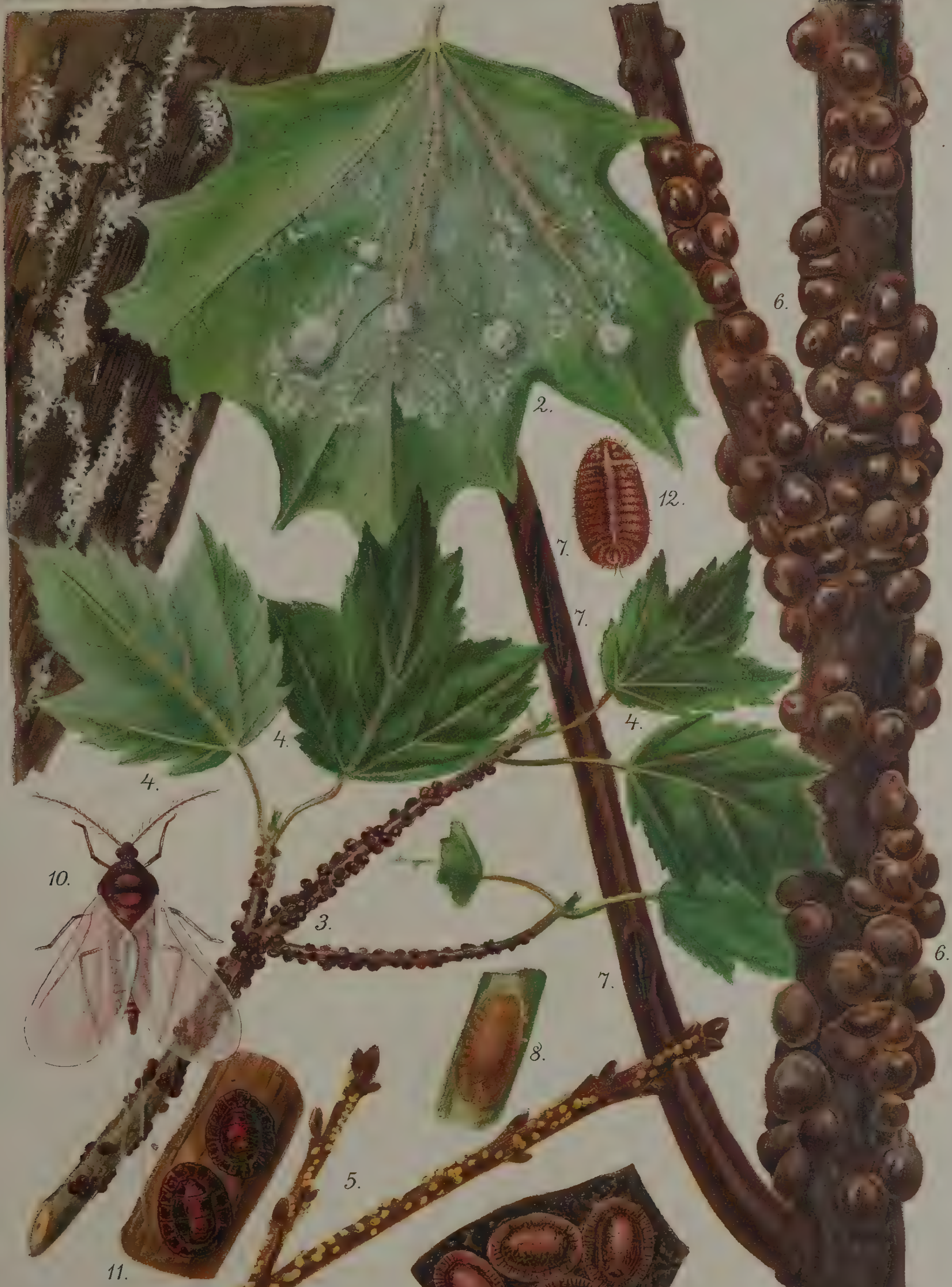

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PLATE 13

a 361

San Jose and other scale insects

San Jose scale, Aspidiotus perniciosus Comst.

1 Badly infested piece of thorn. Scurfy scale, Chionaspis furfura Fitch also present, natural size

2 Male San José scale very much enlarged

3 Female very much enlarged

4 Group of female and young much enlarged

5 Young white and black scales on green twig, showing the surrounding purplish discoloration

6 Cherry twig badly infested with young, some in the white and many in the black stage

7 Young very much enlarged, a number of white, one grayish and a black scale

8 Group of young in the black stage very much enlarged

Oyster scale, Lepidosaphes ulmi Linn.

9 Infested twig, natural size

10 Female very much enlarged

11 Underside showing whitish eggs

12 Male scale very much enlarged

13 Group of old female scales, one with hole from which parasite has emerged and three half grown scales

14 Female of oyster scale

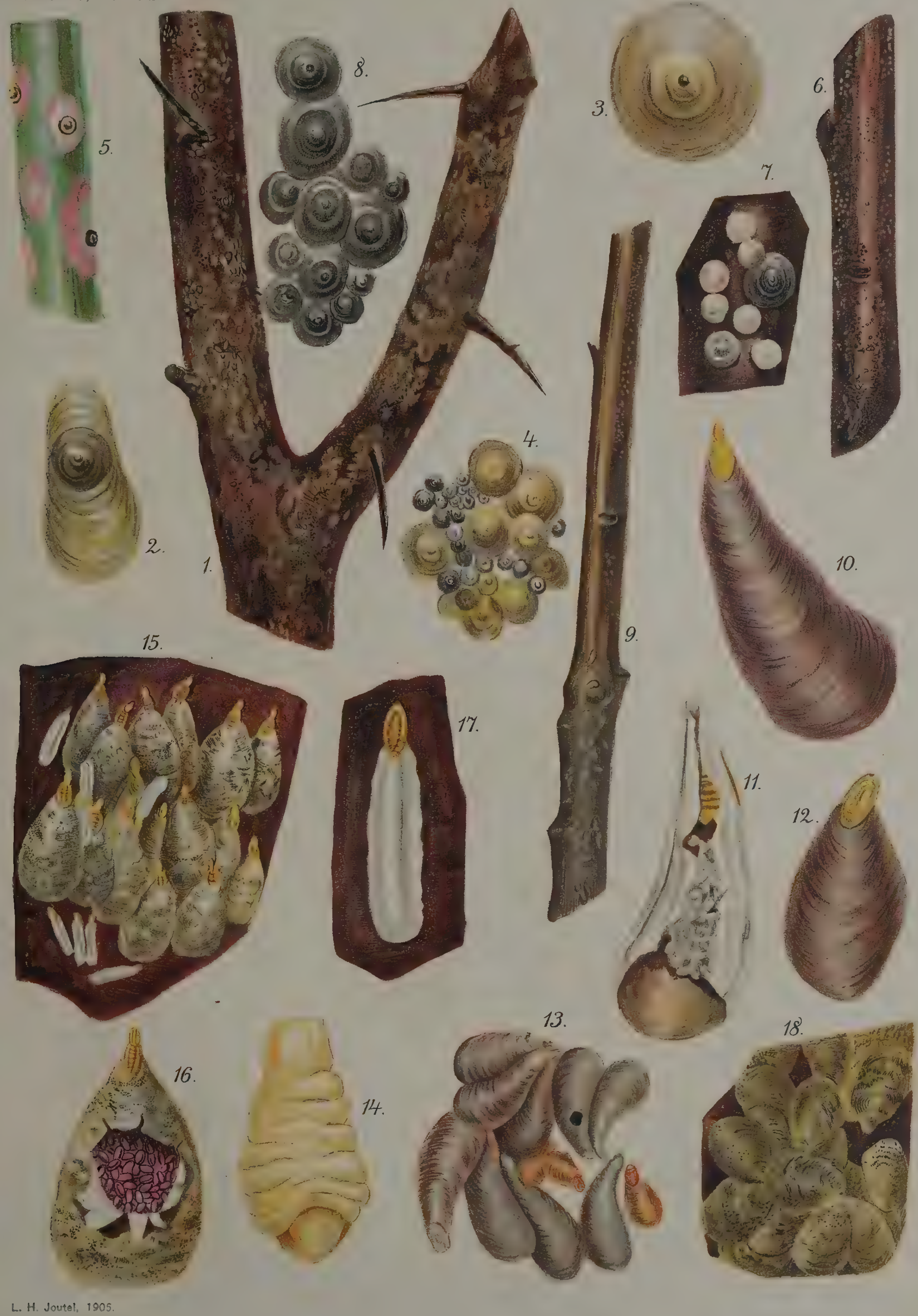
Scurfy scale, Chionaspis furfura Fitch

15 Group showing females and males, much enlarged

16 Female scale very much enlarged, with a portion torn away showing the purplish eggs beneath

17 Male scale very much enlarged

18 Group of old scales somewhat enlarged



L. H. Joutel, 1905.

SAN JOSÉ AND OTHER SCALE INSECTS

PLATE 14

a 363

Rose and other scale insects

Rose scale, Aulacaspis rosae Sandb.

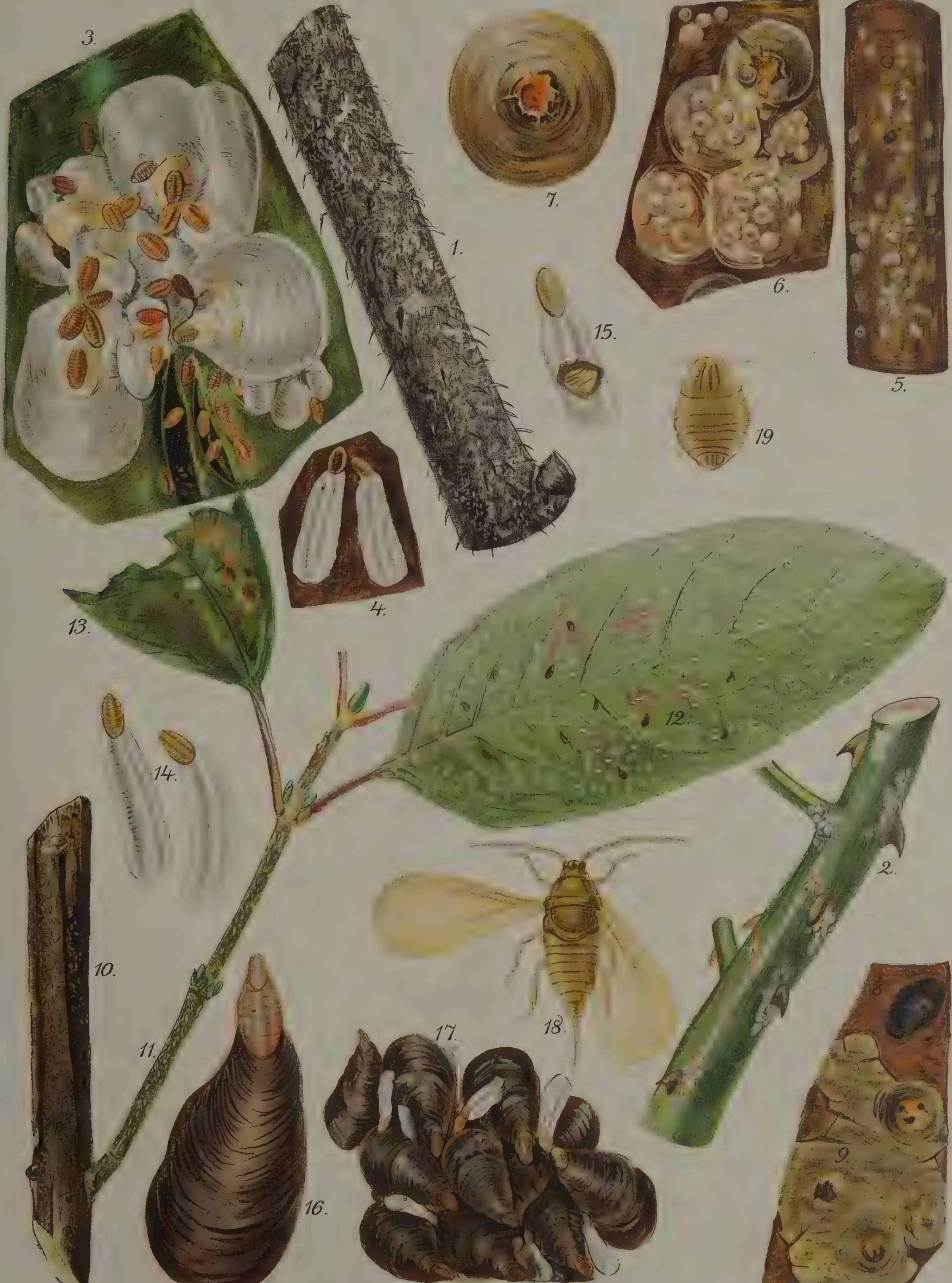
1 Stem of rose badly infested, males predominating, slightly enlarged
2 Stem of rose showing clusters of scales somewhat enlarged
3 Cluster of female scales and young very much enlarged
4 Two male scales very much enlarged

Putnam's scale, Aspidiotus ancylus Putn.

5 Piece of mountain ash infested with Putnam's scale
6 Portion of same very much enlarged, showing young which had settled under the old scales
7 Female scale very much enlarged
8 Male scale somewhat enlarged
9 Female scales on birch, showing their close connection with the outer bark, the scale being almost continuous therewith

Euonymus scale, Chionaspis euonymi Comst.

10 Euonymus stem thickly incrusted with scales
11 Green stem badly infested with young scales
12 Under surface of leaf thickly dotted with young and male scales and a few females
13 Upper side of leaf showing discoloration
14 Male scales very much enlarged
15 Male scale partly broken, showing insect beneath, very much enlarged
16 Full grown female scale, very much enlarged
17 Group of male and female scales, much enlarged
18 Winged male, very much enlarged
19 Crawling young, very much enlarged



L. H. Joutel, 1905.

ROSE AND OTHER SCALE INSECTS

PLATE 15

a 365

Hickory insects

Black walnut caterpillar, Datana integerrima Gr. & Rob.

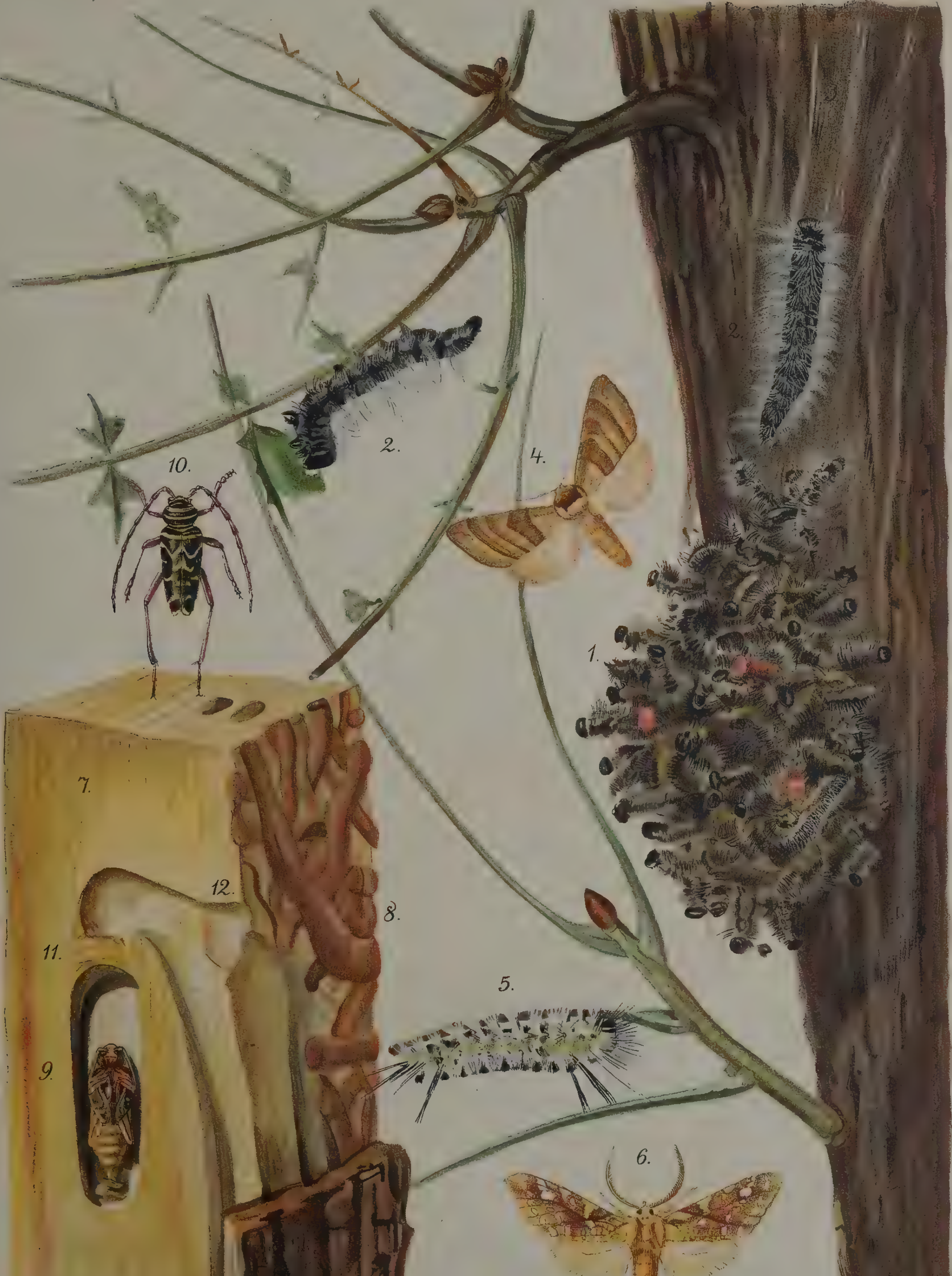
1 Bunch of cast skins
2 Side and dorsal views of full grown larvae
3 Silk spun by larvae on molting place
4 Parent moth

Hickory tussock moth, Halisidota caryae Harr.

5 Side view of full grown larva
6 Parent moth with expanded wings

Painted hickory borer, Cyllene pictus Drury

7 Piece of hickory showing work
8 Larval galleries in sapwood
9 Pupal chamber containing pupa
10 Adult
11 Sawdust stopping exit from pupal chamber
12 Exit hole. This pierces the bark in nature.



L. H. Joutel, 1905.

HICKORY INSECTS

PLATE 16

a 367

Poplar and willow insects

Poplar tent maker, Melalopha inclusa Hübn.

1 Larva on its nest

2 Moth of same

Elm sawfly, Cimbex americana Leach

4 Larva

5 Adult of same

6 Cocoon

Mottled willow borer, Cryptorhynchus lapathi Linn.

7 Portion of willow branch cut to show work

8 Adult, dorsal aspect

9 Shrunken, discolored area over larval galleries

Puss moth, Harpyia sp.

10 Side view of larva

11 Eggs

12 Cocoon from which moth has emerged

Sesia albicornis Hy Ed.

13 Pupal cases

Cottonwood leaf beetle, Melasoma scripta Fabr.

14 Eggs

15 Full grown larva

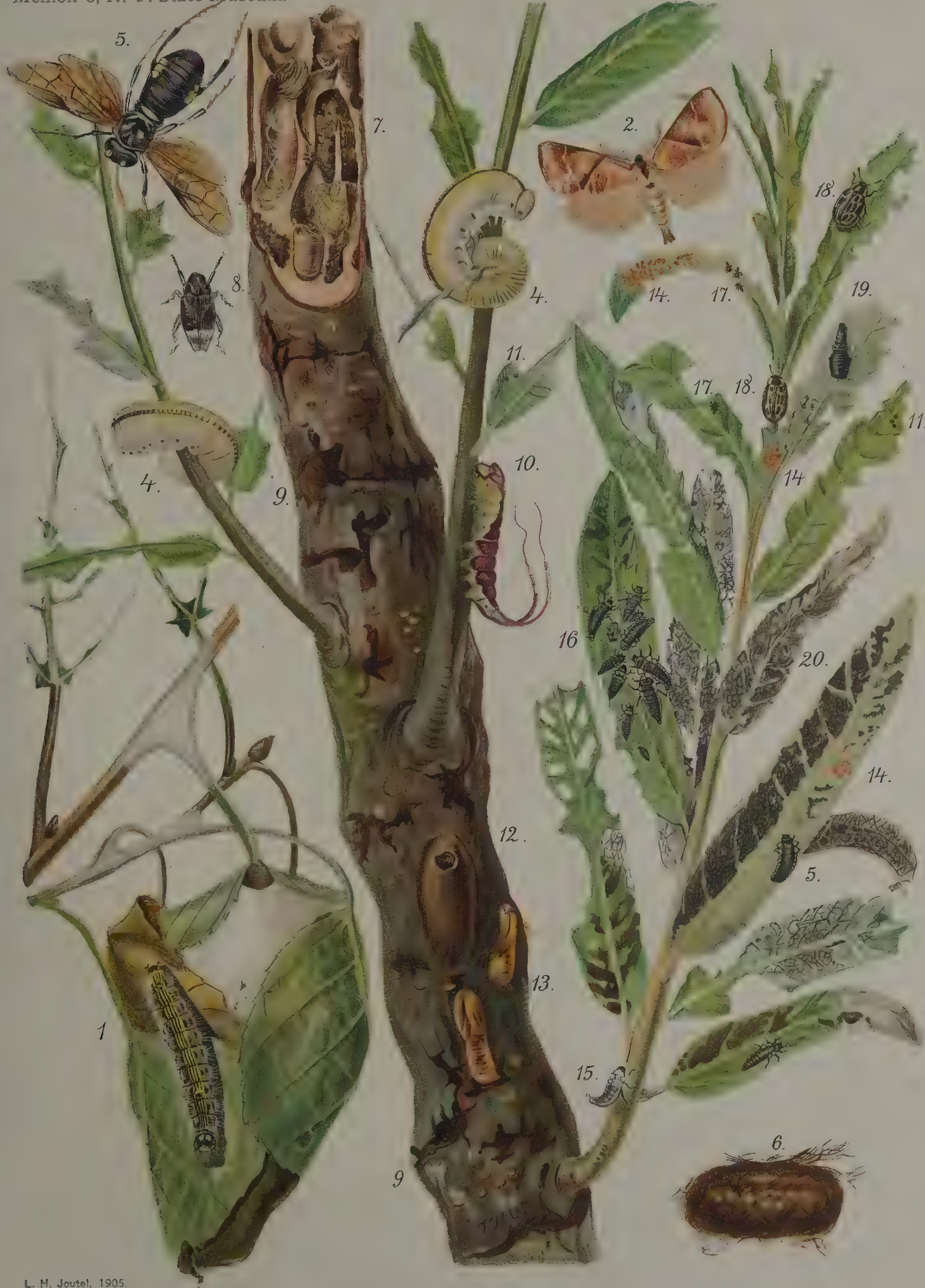
16 Group of larvae

17 Young larvae

18 Beetles or "hard shells" showing variation in marking

19 Pupa or "hanger"

20 Badly eaten leaves showing characteristic method of feeding



L. H. Joutel, 1905.

POPLAR AND WILLOW INSECTS

PLATE 17

a 369

Yellow striped oak caterpillar, *Anisota senatoria* Abb. & Sm.

1 Egg mass on underside of oak leaf
2 Eggshells on partly eaten leaf
3 Leaf stalk bearing shrunken larvae infested by parasite and showing the characteristic feeding of nearly full grown caterpillars
4 Side view of nearly full grown larvae
5 Recently hatched larvae feeding side by side and showing the skeletonizing in the earlier stages
6 Male, natural size
7 Female depositing eggs

Buck or Maia moth, *Hemileuca maia* Drury

8 Side view of full grown larva
9 Male, showing wings of one side only
10 Egg mass

Archips fervidana Clem.

11 Adult, enlarged
12 Nest composed of partly eaten, curled leaves

Serica trociformis Burm.

13 Beetle on leaf, natural size
14 Same enlarged

Two spotted tree hopper, *Enchenopa binotata* Say

15 Side view of adult

Archasia galeata Fabr.

16 Side view of adult of a peculiar tree hopper

Thelia acuminata Fabr.

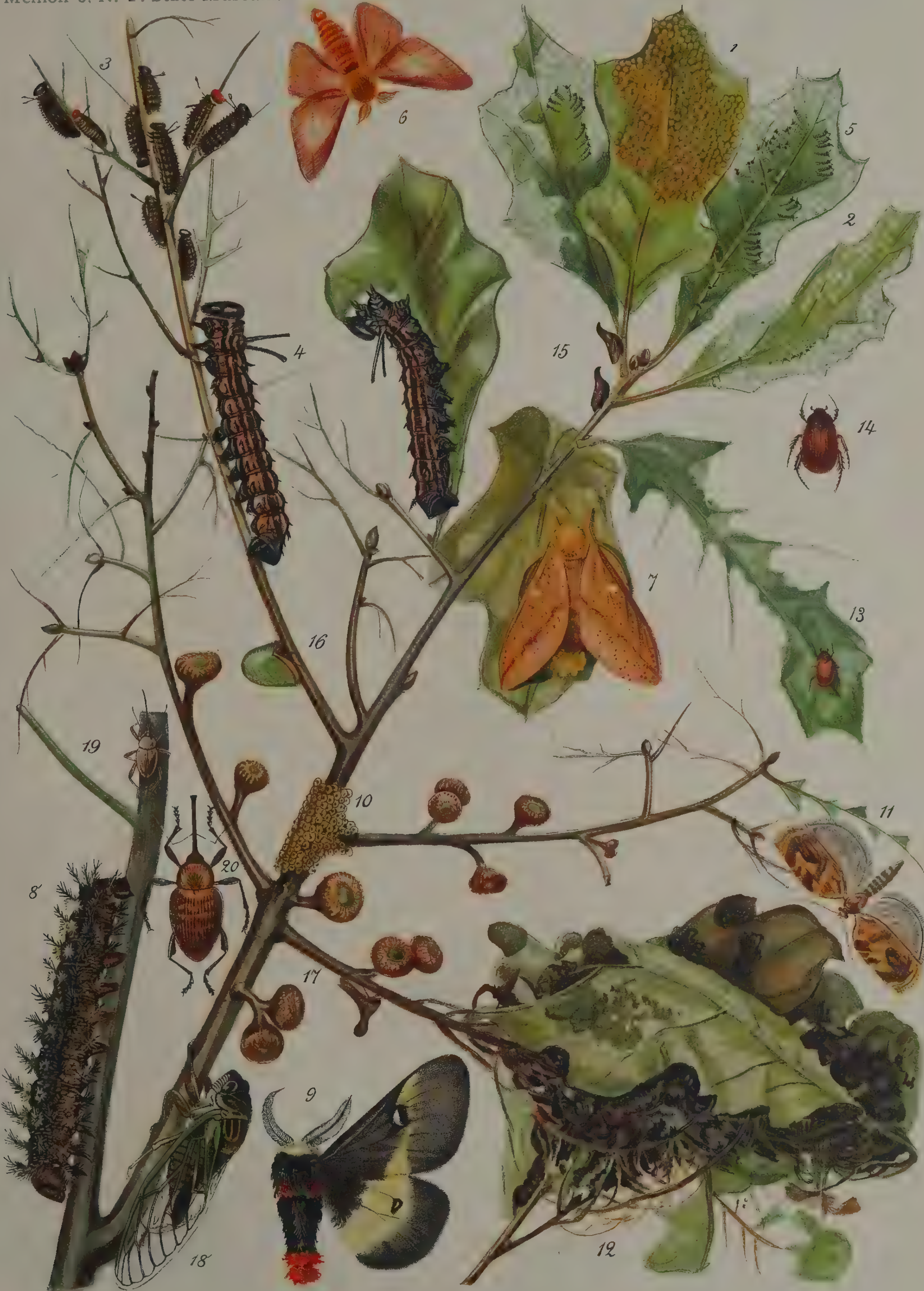
17 Side view of another tree hopper

Dog day cicada or harvest fly, *Tibicen tibicen* Linn.

18 Side view of adult in resting position

Acorn weevil, *Balaninus nasicus* Say

19 Adult on twig, natural size
20 Same enlarged



OAK INSECTS

PLATE 18

a 371

Larch insects

Woolly larch aphid, Chermes strobilobius Kalt.

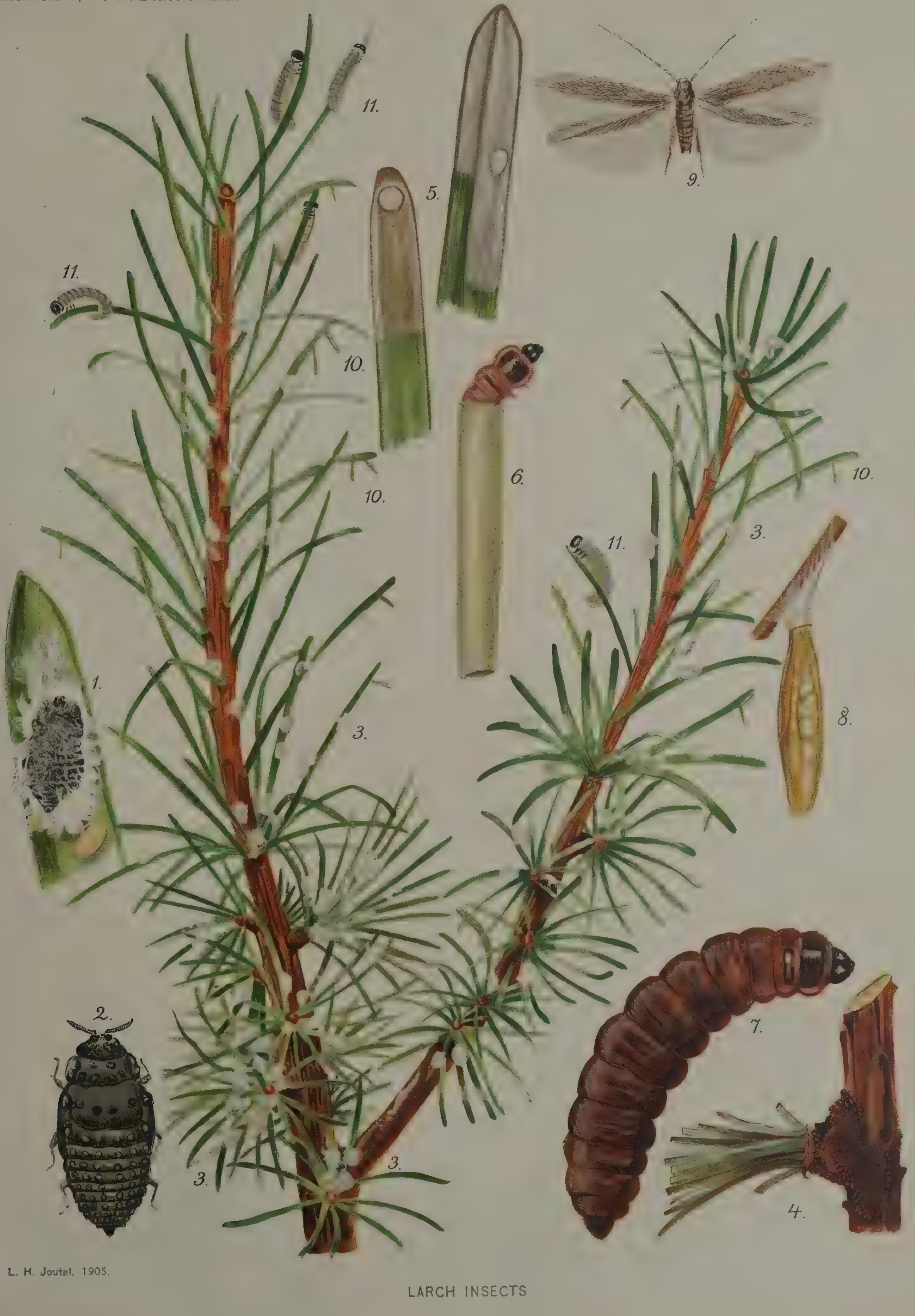
1 Young on leaf, showing the cottony filaments and near by the egg of a predaceous syrphus fly, very much enlarged
2 Young aphid, very much enlarged
3 Woolly females on leaves, natural size
4 Egg mass at base of a whorl of leaves, very much enlarged

Larch case bearer, Coleophora laricella Hübn.

5 Mined tips of larch needles, showing hole through which the caterpillar feeds, much enlarged
6 Caterpillar partly out of its peculiar case, much enlarged
7 Larva very much enlarged
8 Cocoon much enlarged
9 Moth much enlarged
10 Case bearers on the leaves, natural size

Larch sawfly, Lygaeonematus erichsonii Hartg.

11 Larvae on foliage, showing characteristic positions



L. H. Joutel, 1905.

LARCH INSECTS

PLATE 19

a 373

White pine insects

Imperial moth, Basilona imperialis Drury

1 Side view of nearly full grown larva

Pine bark aphid, Chermes pinicorticis Fitch

2 Masses on the stem of a young pine

White pine weevil, Pissodes strobi Peck

3 Pupal cells under bark of pine log

4 Burrows of larvae in bark

5 Portion of dead shoot killed by the insect, showing the circular exit holes, the borings of the insect in the upper part and the shrunken area extending down on the affected portion of the twig

6 Pupal cells of white pine weevil within the wood, showing method of escape and also a few exit holes in the shrunken affected bark

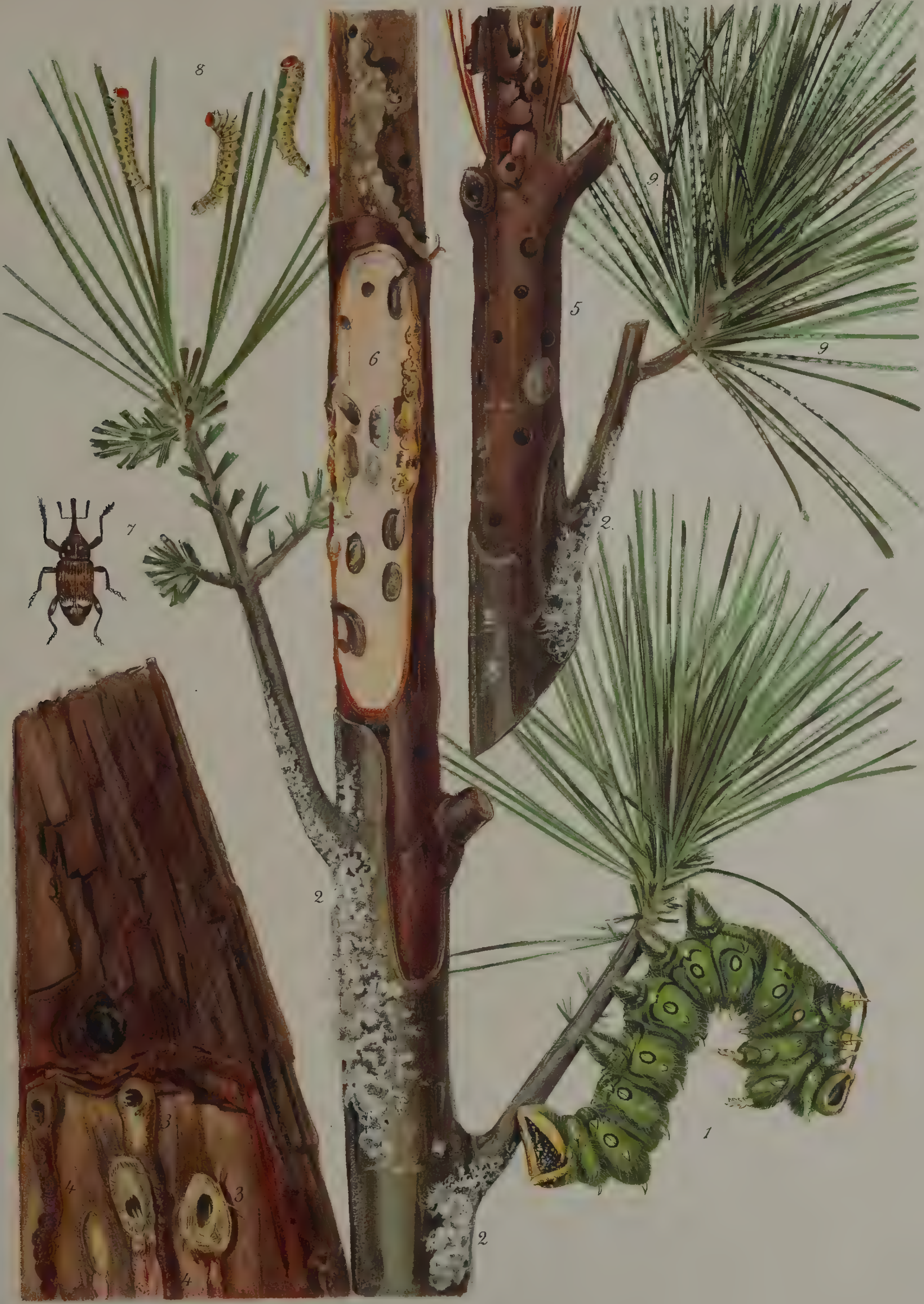
7 Adult weevil, enlarged

LeConte's sawfly, Lophyrus lecontei Fitch

8 Larvae in resting position on needles, showing below the stubs of devoured foliage

Pine leaf scale insect, Chionaspis pinifoliae Fitch

9 Numerous scales on pine needles



L. H. Joutel, 1902

WHITE PINE INSECTS

PLATE 20

a 375

Insects affecting hard pine

Pitch twig moth, Evetria comstockiana Fern.

1 Pitch mass with pupal shell protruding therefrom in one case; the other shows old and recent pitch.

21 Adult, enlarged

Pitch midge, Cecidomyia resinicola O. S.

2 Pitch mass showing protruding pupal cases

Nantucket pine moth, Evetria frustrana Scudd.

3 Infested shoot showing the abortive growth

Pine needle gall fly, Cecidomyia pini-rigidae Pack.

4 Needles deformed by this insect

4*a* Work on needles of the previous year

Pine leaf miner, Paralechia pinifoliella Chamb.

5 Affected needles, note the brown tips

23 Adult, enlarged

Fir sawfly, Lophyrus abietis Harr.

6 Larvae in natural position on the needles; below are stubs of eaten foliage

6*a* Cocoon of same at base of pine needles

Pine chrysomela, Glyptoscelis pubescens Fabr.

7 Adult, much enlarged

Pales weevil, Hylobius pales Herbst.

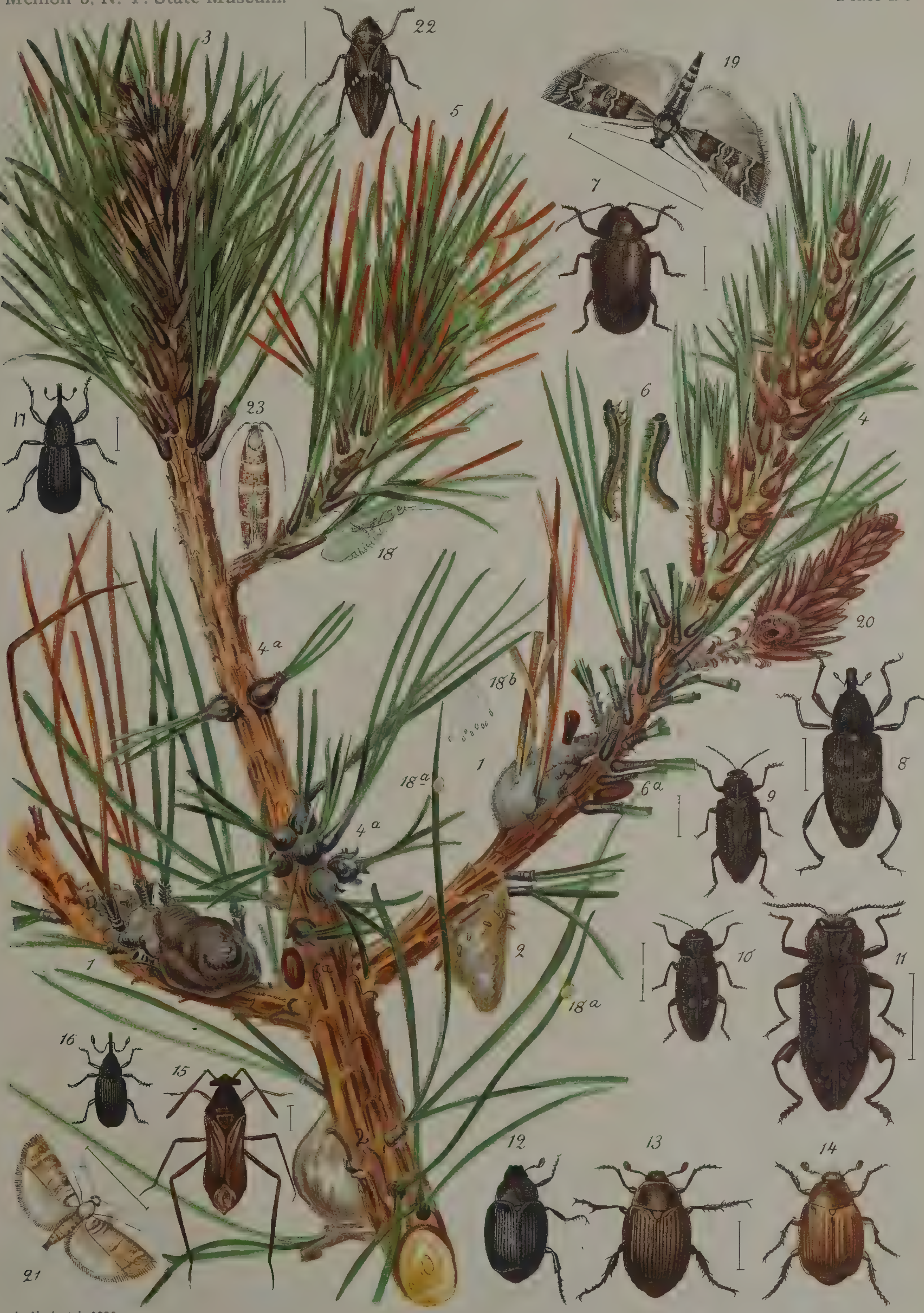
8 Adult, much enlarged

Chrysobothris pusilla Lap. & Gory

9 Adult, much enlarged

Chrysobothris floricola Gory

10 Adult, enlarged



L. H. Joutel, 1902.

HARD PINE INSECTS

Chrysobothris dentipes Germ.

11 Adult, much enlarged

Light loving grapevine beetle, Anomala lucicola Fabr.

12, 13 and 14 Varieties of this beetle, a species very abundant on hard pines, much enlarged

Pilophorus crassipes Uhl.

15 Adult, much enlarged

Magdalis alutacea Lec.

16 Adult, much enlarged

Magdalis perforata Horn.

17 Adult, much enlarged

Lace-winged fly, Chrysopa sp.

18 Side view of adult
18*a* Cocoons of same on needles
18*b* Stalked eggs of lace-winged fly

Pine tip moth, Pinipestis zimmermani Grote

19 Adult
20 Work in a shoot, showing its abortive character and the peculiar small pitch mass near its base

Spittle insect, Aphrophora parallela Say

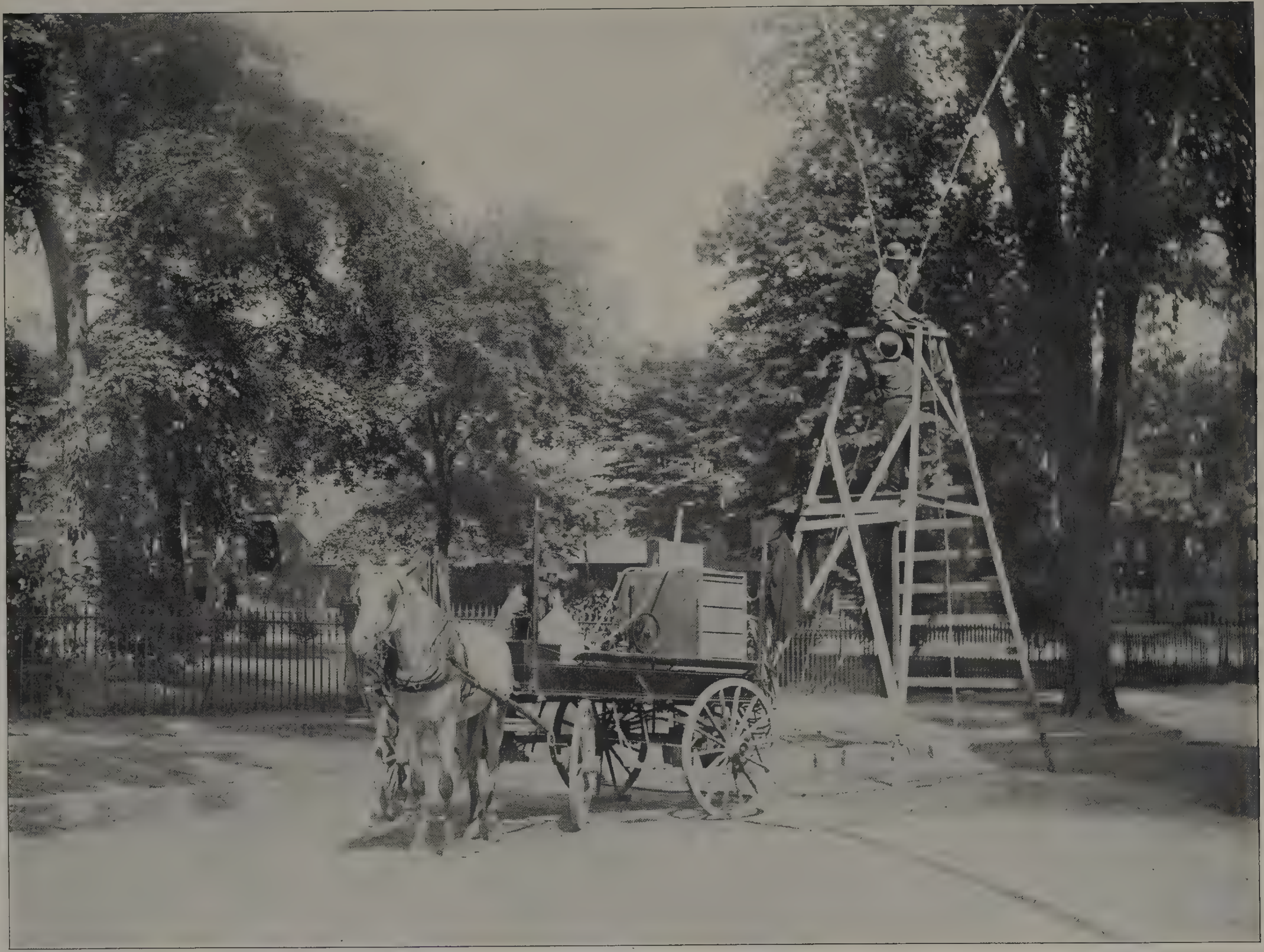
22 Adult, enlarged

PLATE 21

a 379

Power spraying outfit at work in an Albany park

a 380



Power spraying outfit in operation

PLATE 22

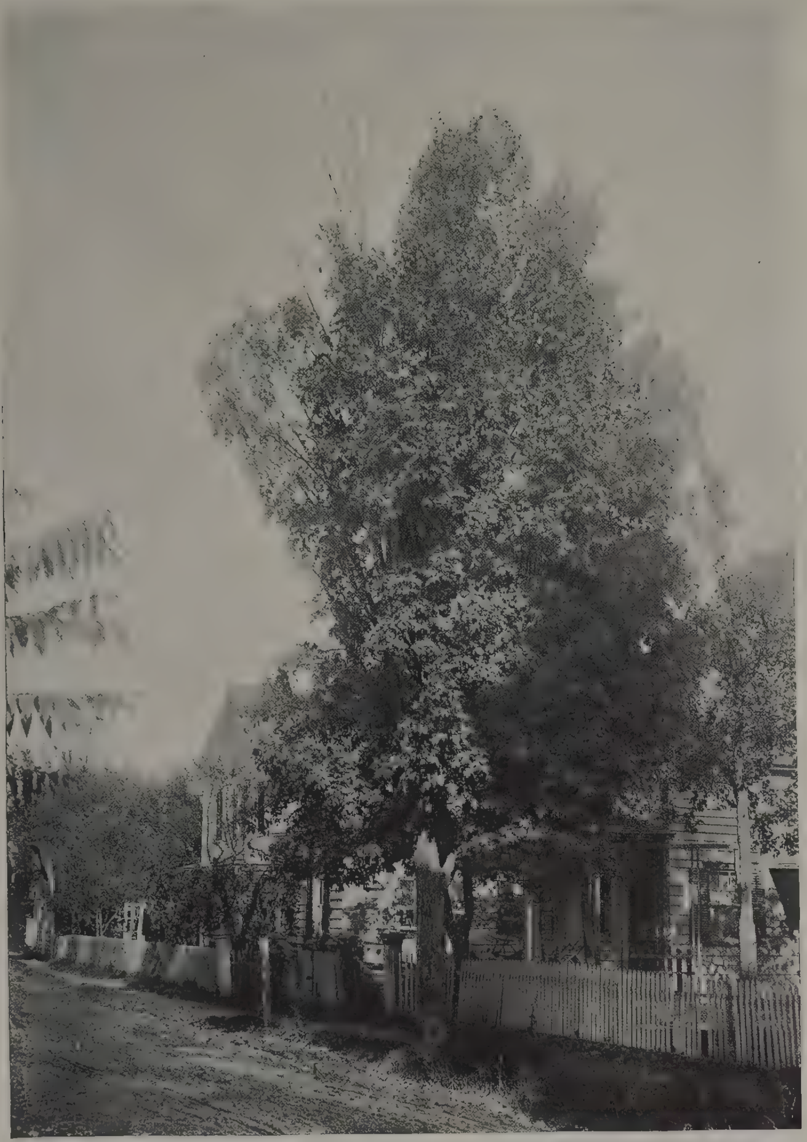
a 381

Sugar maple borer, Plagionotus speciosus Say

1 Maple in leaf showing dead branches killed by the borer

2 Maple in winter showing broken tips of branches killed by the borer

Plate 22



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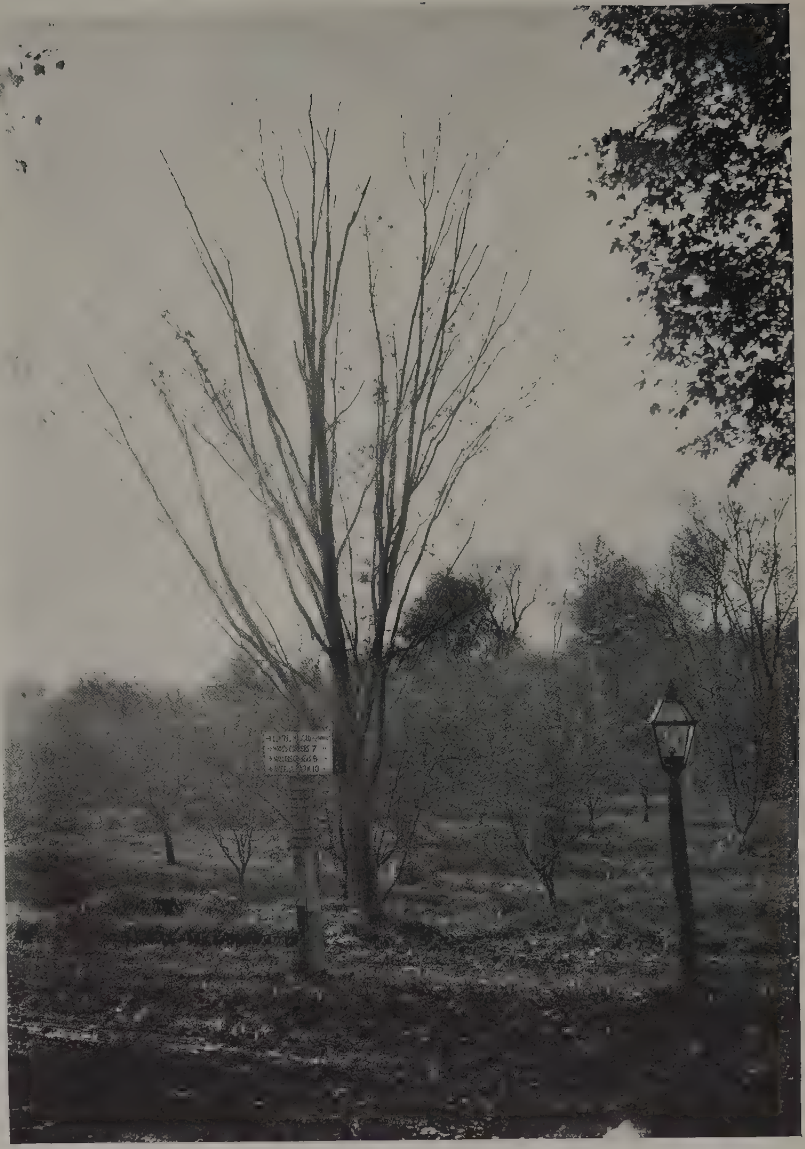


2

Work of sugar maple borer

Nassau N. Y. 1901

PLATE 23

a 383

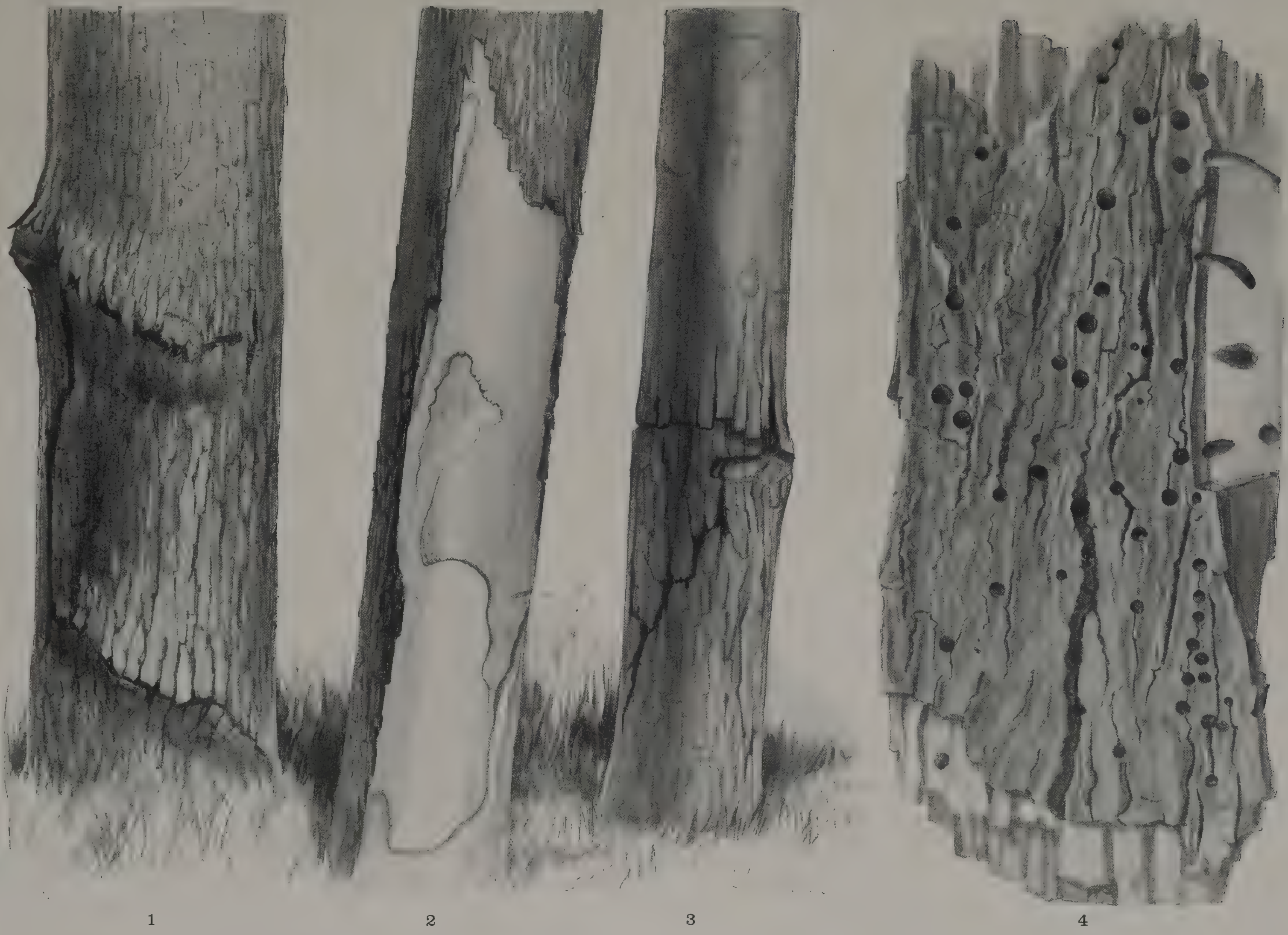
Sugar maple borer, Plagionotus speciosus Say

1 Ridges of bark formed over recent borings

2 Exposed dead area showing the conspicuous grooves made by the grubs

3 Ridging and cracking of bark over a badly wounded area

4 Section of dead trunk showing borings and exit holes of the pigeon Tremex, Tremex columba Linn. and the smaller holes of its parasite, the lunate long sting, Thalessa lunator Fabr.



Work of sugar maple borer

PLATE 24[1]

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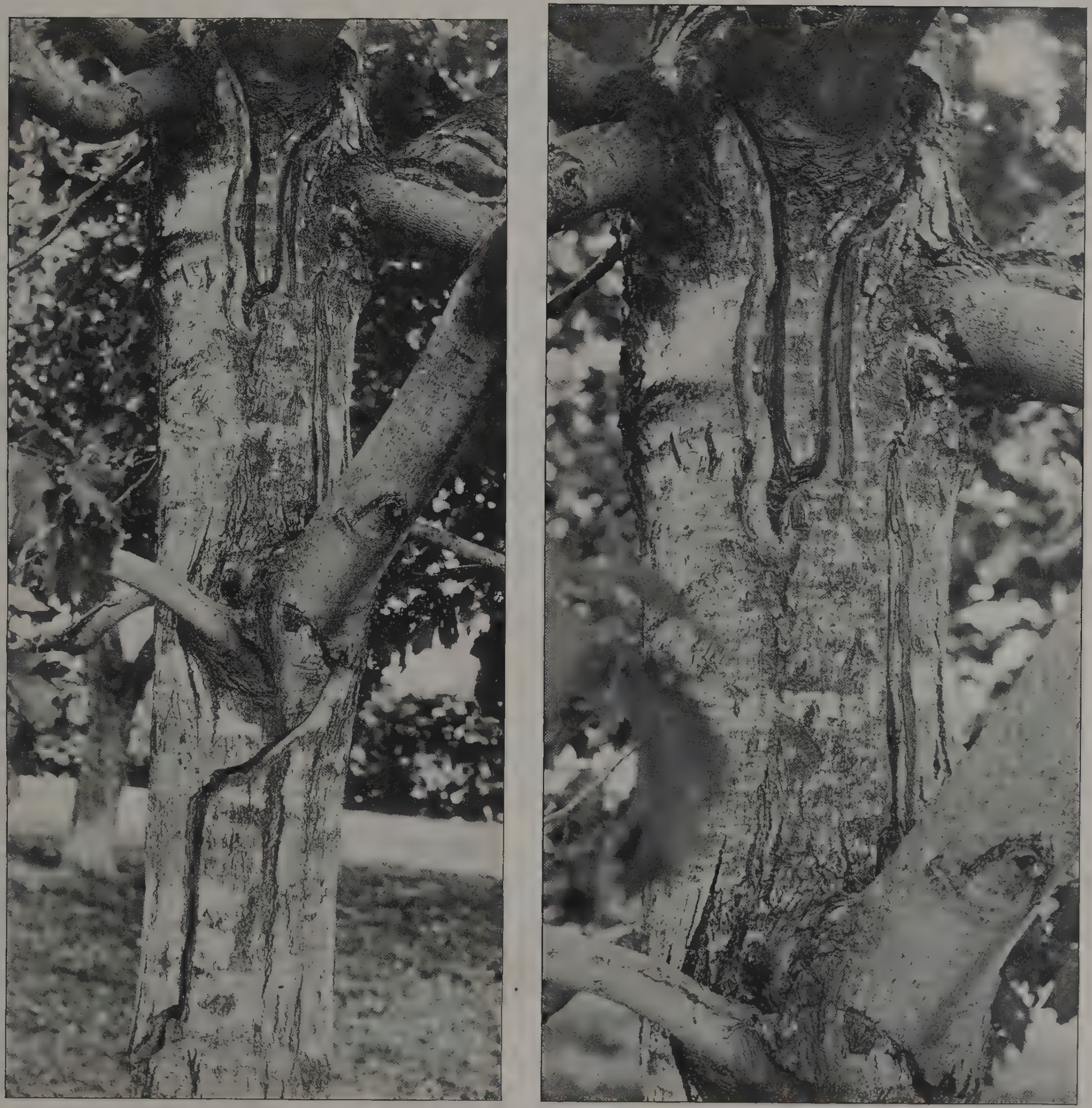
[1] Figures 1, 2, from plate 24 and figure 1 from plate 25 from photographs taken June 28, 1904, by Dr W. W. Williams, Hilton N. Y.

Sugar maple borer, Plagionotus speciosus Say

1 Portion of trunk of living maple, showing recent galleries which have been exposed by cutting

2 Upper portion of galleries more enlarged



1 Work of sugar maple borer in living trees 2

Hilton N. Y. 1904

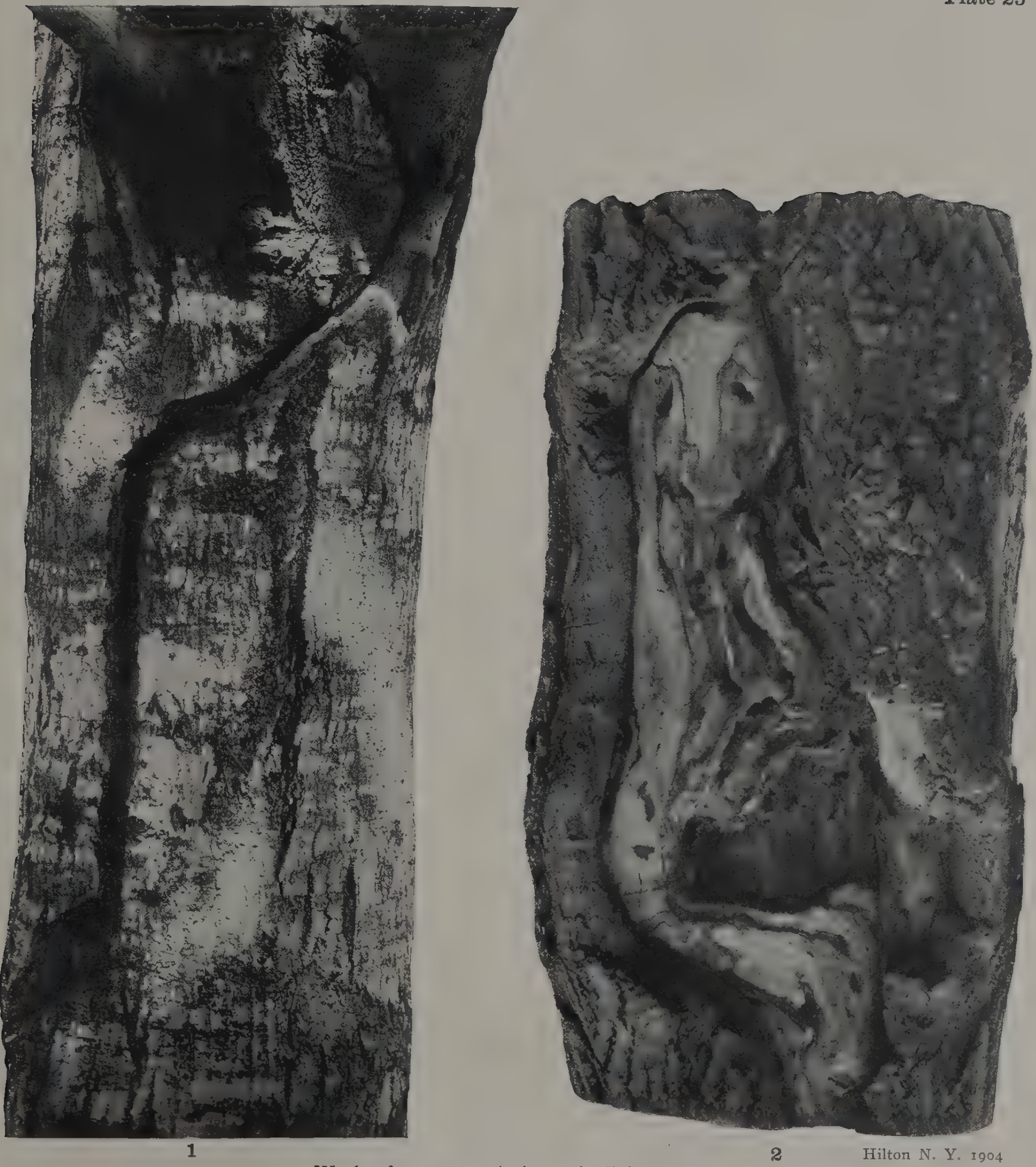
PLATE 25

a 387

Sugar maple borer, Plagionotus speciosus Say

1 Lower portions of galleries shown on plate 24, figure 1, more enlarged

2 Portion of exposed trunk badly scored by the grub. The overlying bark died, cracked and fell off, exposing the wood to the weather and decay



1 2 Hilton N. Y. 1904

Work of sugar maple borer in living trees

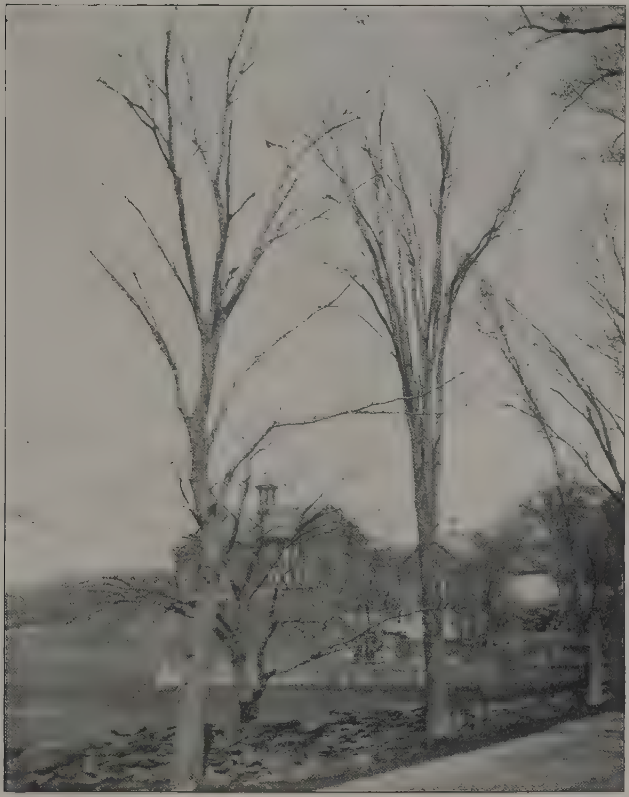
PLATE 26

a 389

Elm borer, Saperda tridentata Oliv.

Two young elms in a long row, killed by the elm borer in association with the elm snout beetles Magdalis armicollis Say and M. barbita Say

Photograph taken June 1903, by J. A. Otterson, Berlin Mass.



Berlin Mass. June 1903

Work of elm borer and elm snout beetles

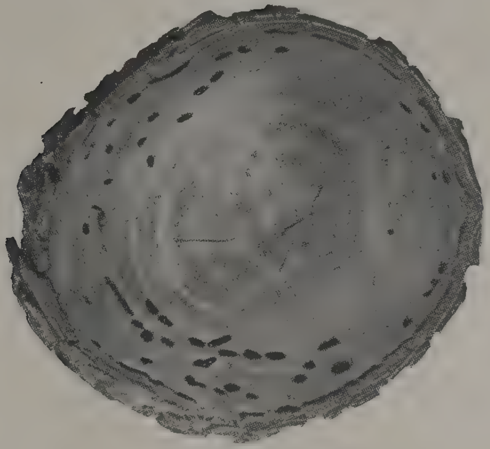
PLATE 27

a 391

Elm borer, Saperda tridentata Oliv.

1 Section of badly infested limb

2 Wood surface of badly infested limb



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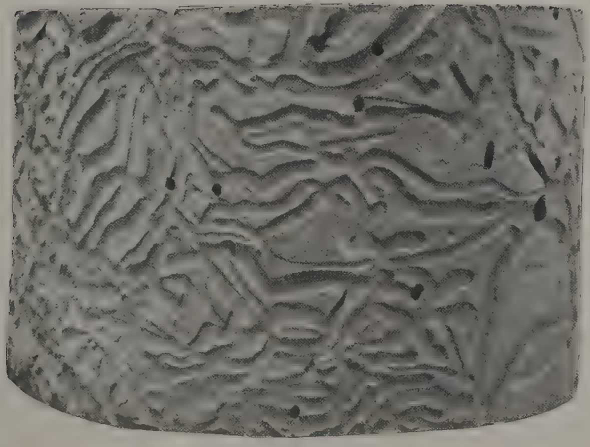


2

Work of elm borer

PLATE 28

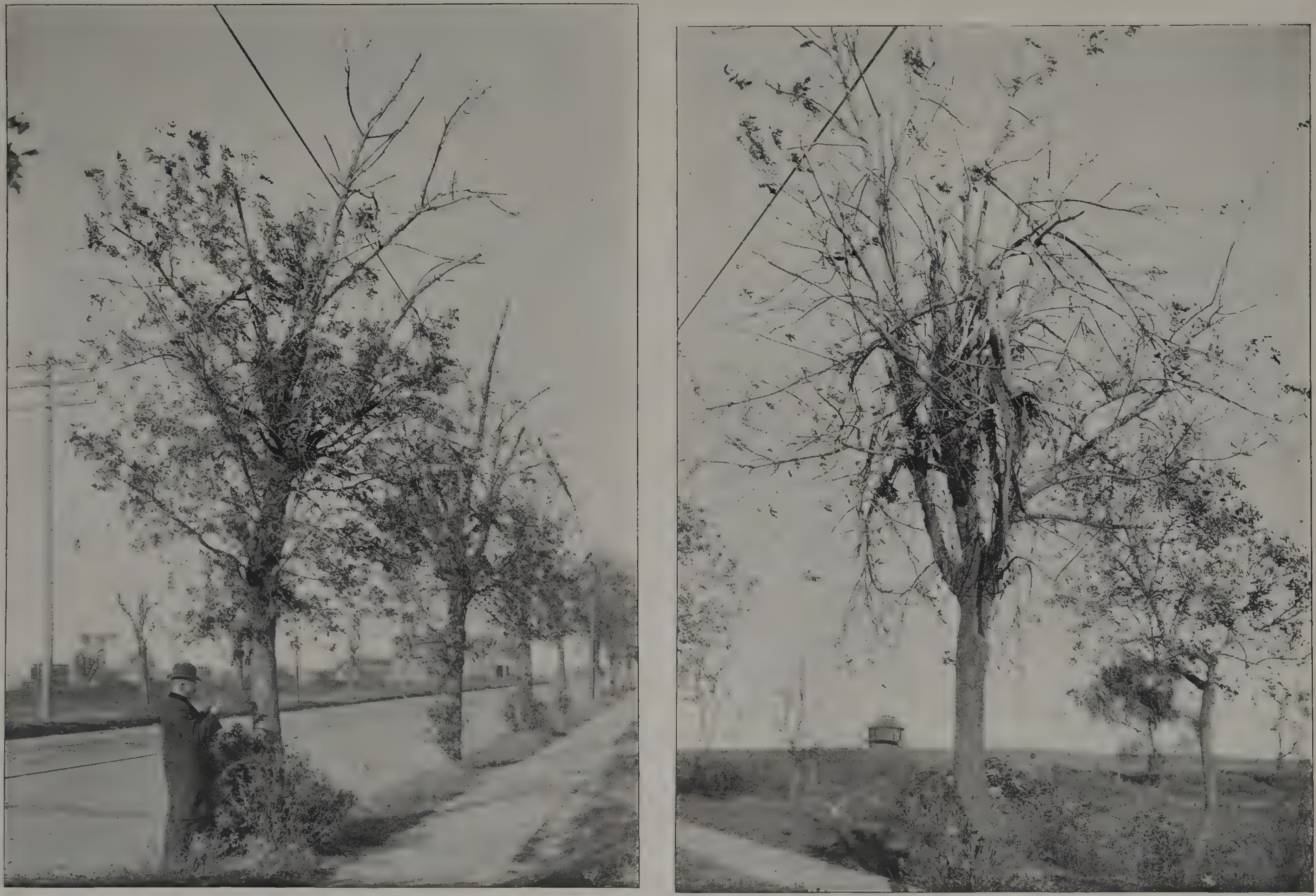
a 393

Leopard moth, Zeuzera pyrina Fabr.

1 Row of soft maples badly injured by this pest

2 A single tree showing limbs broken as a result of weakening by the borers. Both from Astoria L. I., 1900

Plate 28



1 Work of leopard moth 2

Astoria L. I. 1900

PLATE 29

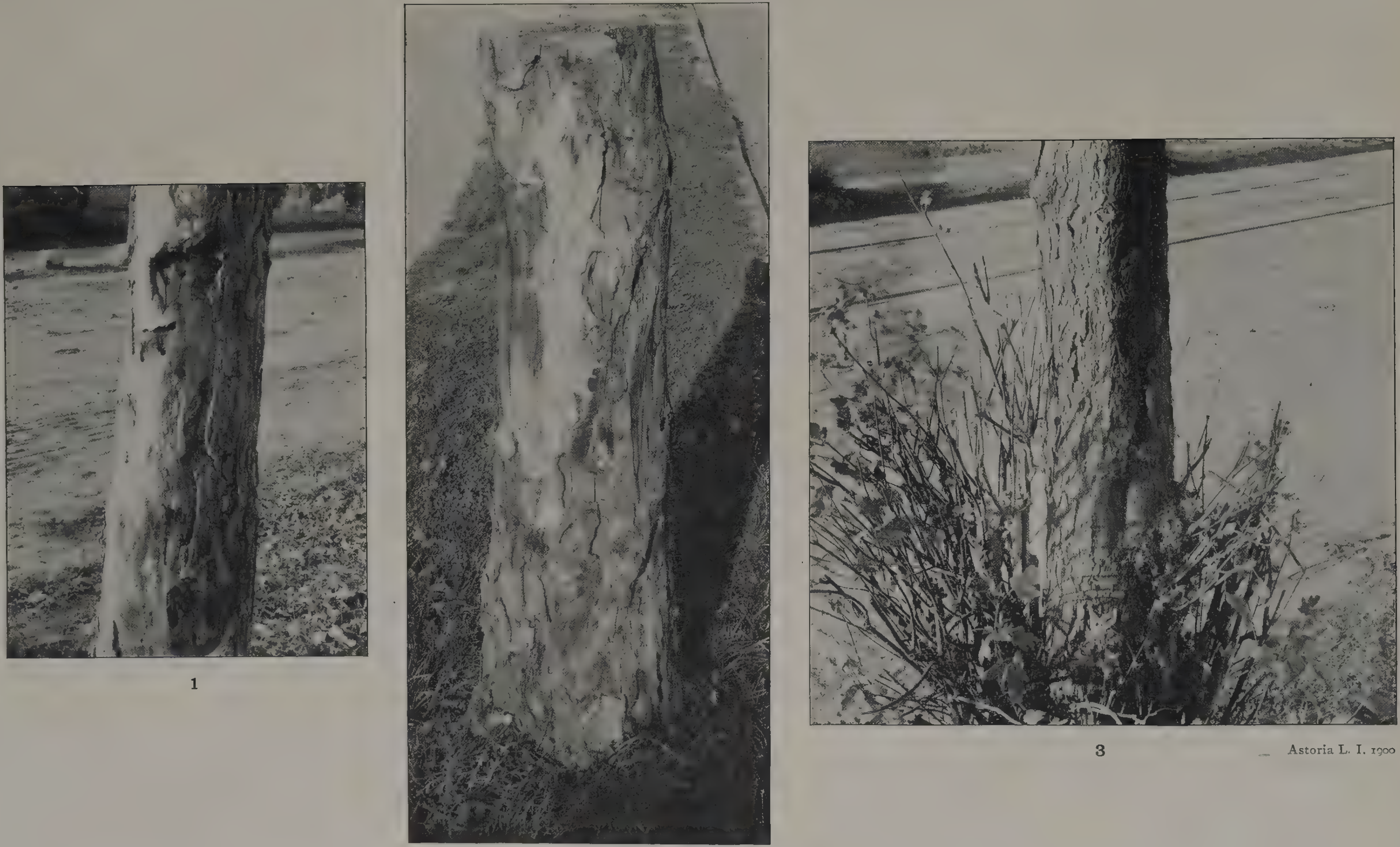
a 395

Leopard moth, *Zeuzera pyrina* Fabr.

1 Portion of trunk of soft maple, showing the large scars made by this borer

2 Another stump exhibiting a more advanced stage of the work of the same insect

3 Trunk of a soft maple, illustrating the tendency of affected trees to throw out suckers at the base, and also showing masses of borings lodged in the young growth. All from Astoria L. I., 1900



1

2

3

Astoria L. I. 1900

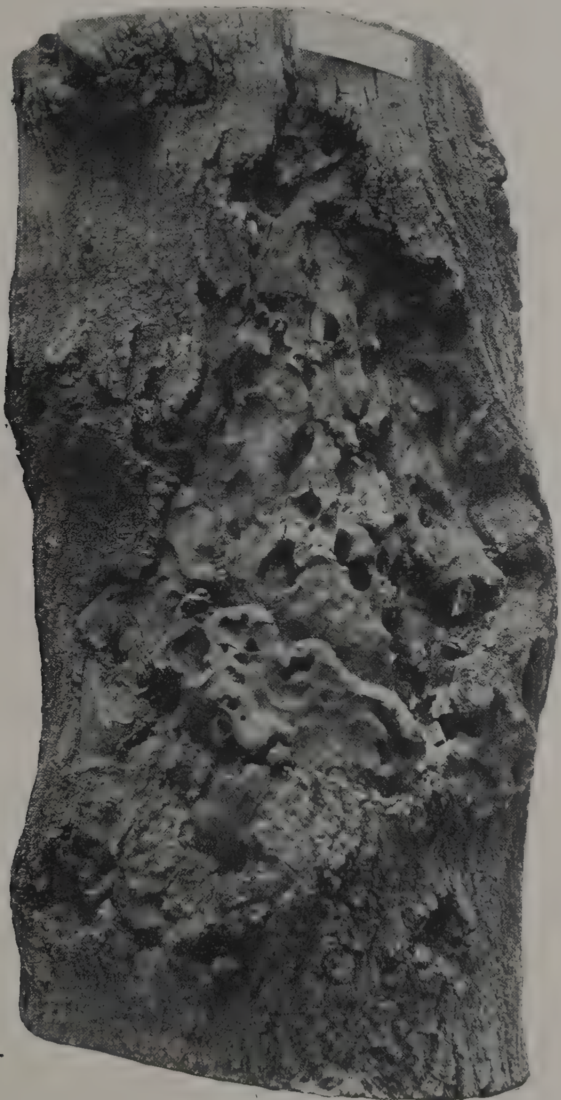
Work of leopard moth

PLATE 30

a 397

Carpenter worm, Prionoxystus robiniae Peck

Work of same in ash, showing a very large dead area with numerous irregular galleries



Work of carpenter worm in ash

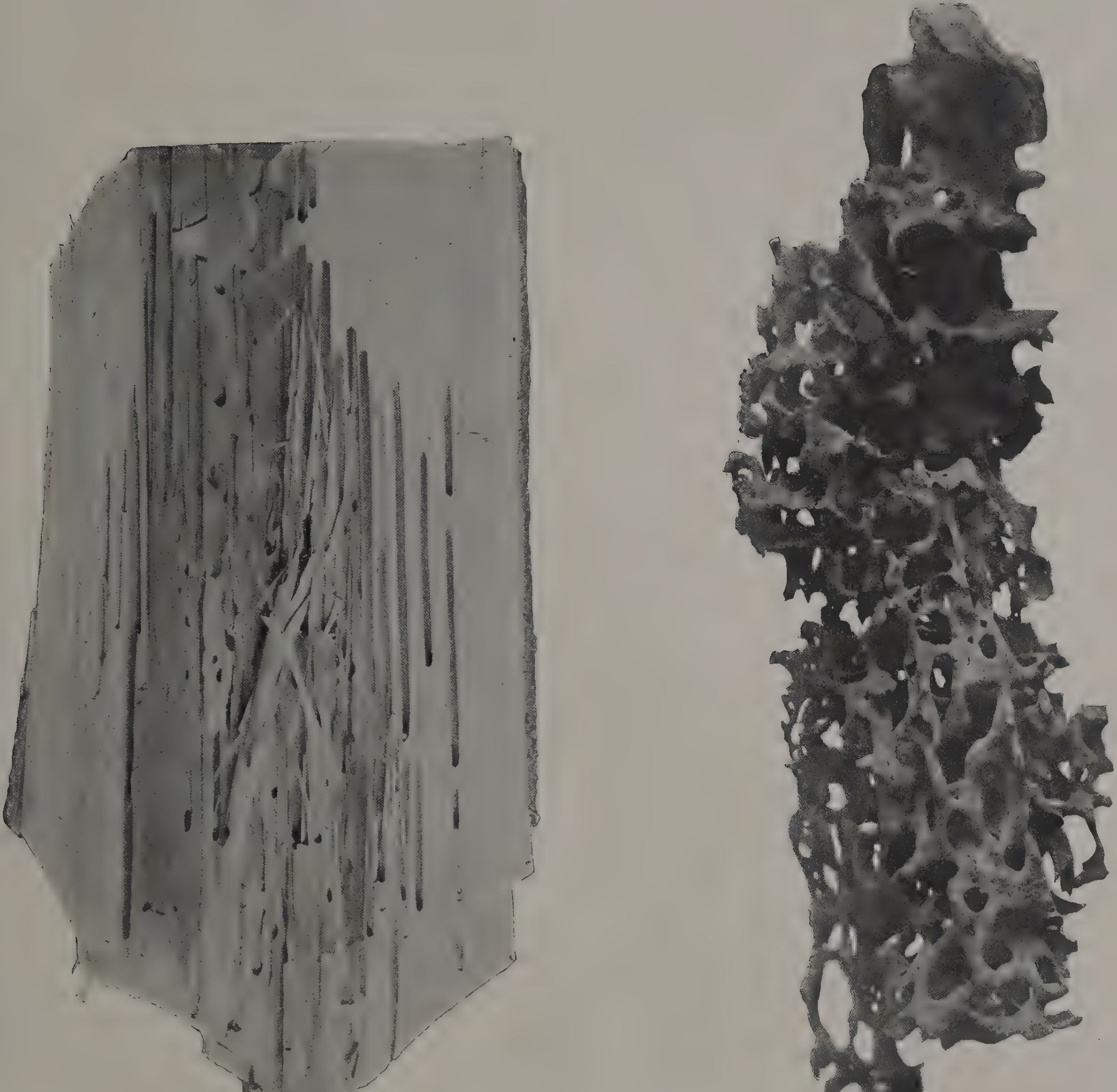
PLATE 31

a 399

Large black carpenter ant, Camponotus herculaneus Linn.

1 Work in balsam, showing the regular galleries, probably modified by the alternate hard and soft lamellae in the wood

2 Work of the same insect in elm, showing the extremely irregular character of the galleries



1 2

Operations of large black carpenter ant

PLATE 32

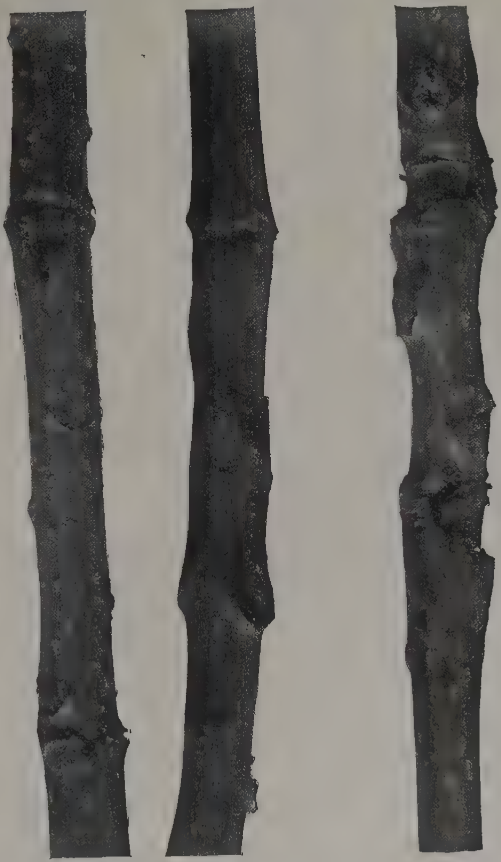
a 401

Mottled willow borer, Cryptorhynchus lapathi Linn.

1 Small Carolina poplar twigs showing the work of this insect

2 A more advanced stage of the same, with two twigs sectioned to illustrate the character of the galleries

Plate 32



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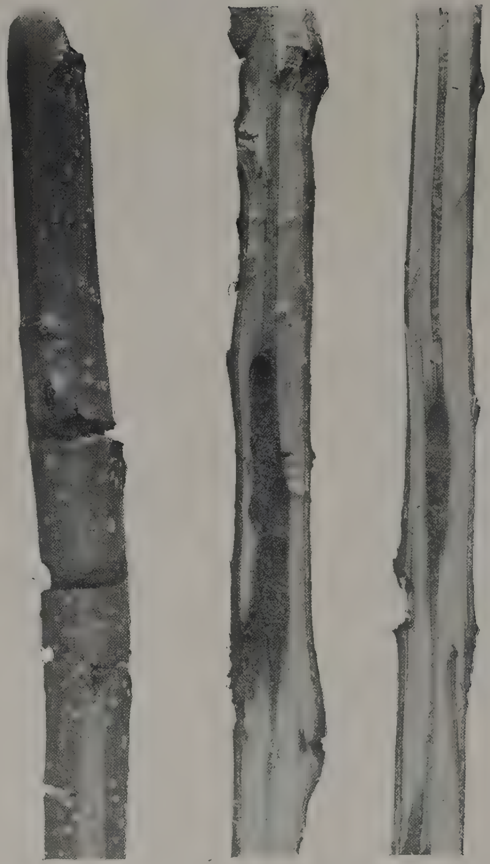


2

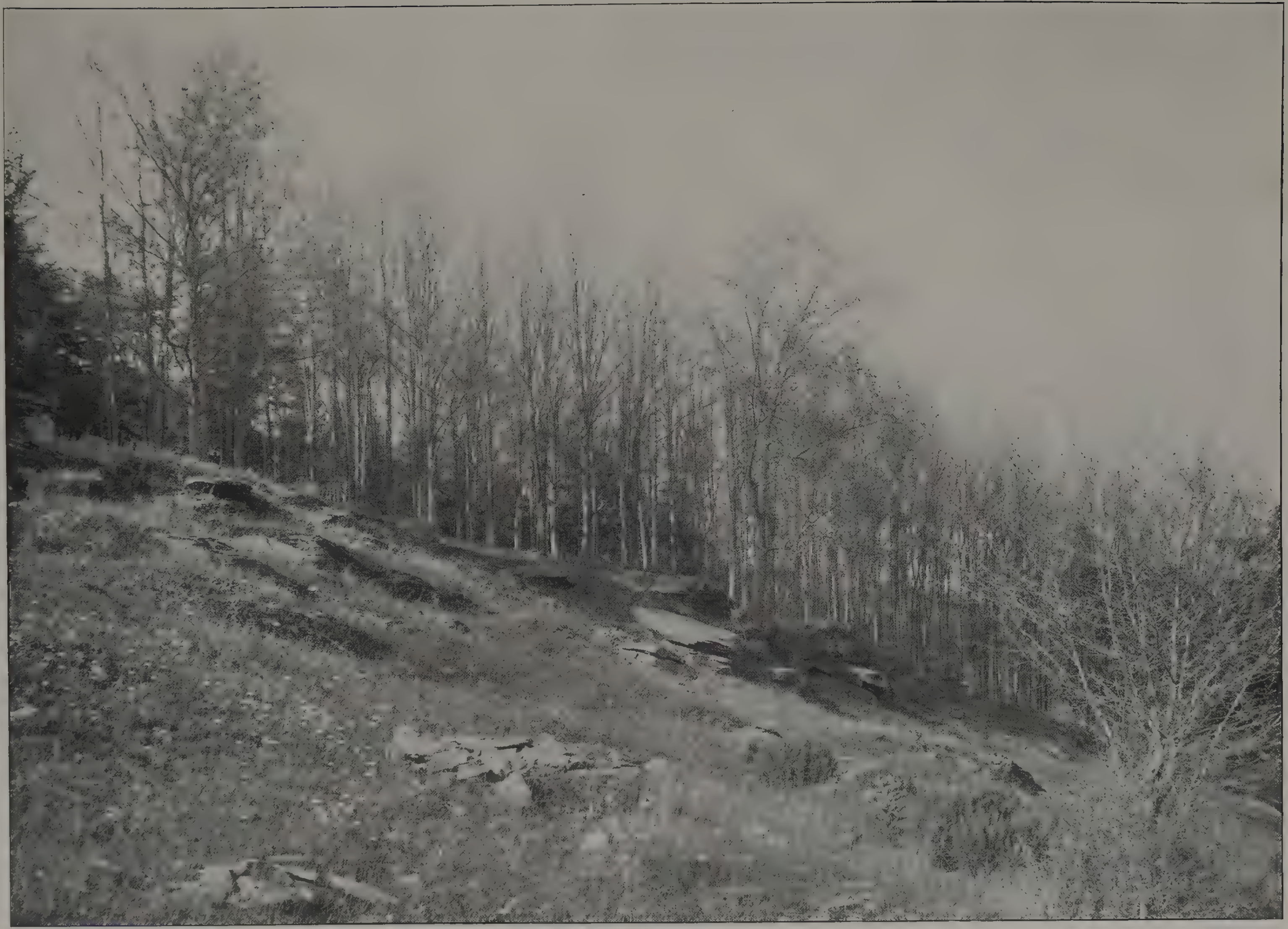
Work of mottled willow borer

PLATE 33

a 403

Forest tent caterpillar, Malacosoma disstria Hübn.

Defoliated sugar orchard in Arkville, Delaware county, photographed July 8, 1898



Work of forest tent caterpillar

Arkville N. Y. July 8, 1898

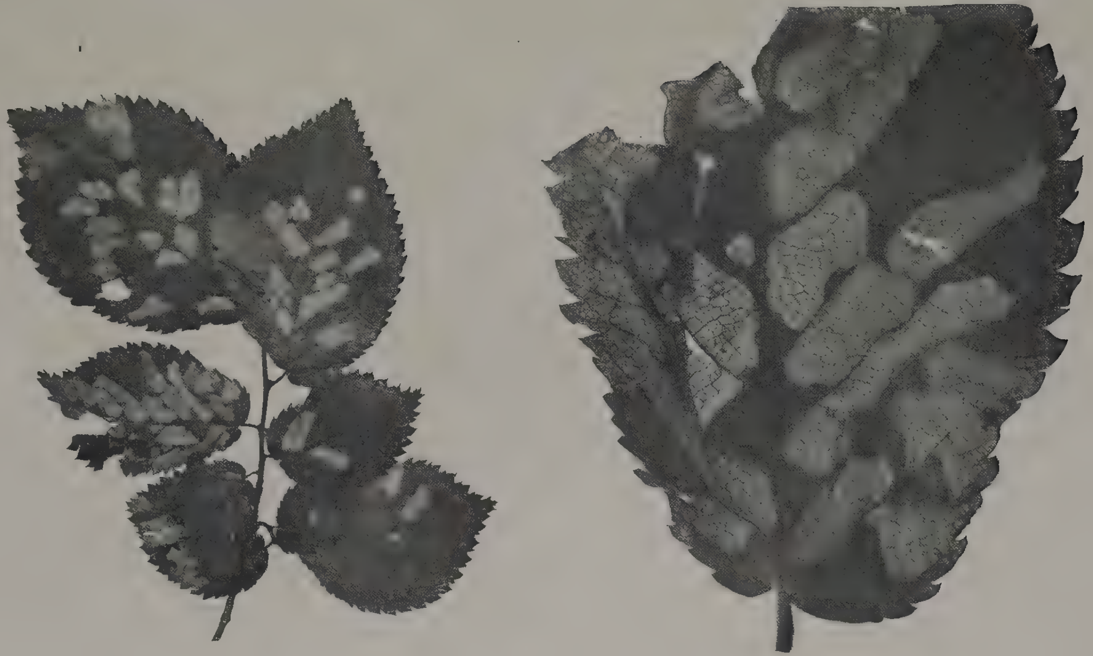
PLATE 34

a 405

European elm case bearer, Coleophora limosipennella Dup.

1 Elm twig with leaves, showing the irregular rectangular mined areas

2 Portion of leaf much enlarged, illustrating the character of the skeletonizing and the circular hole through which the larva eats out the tissues



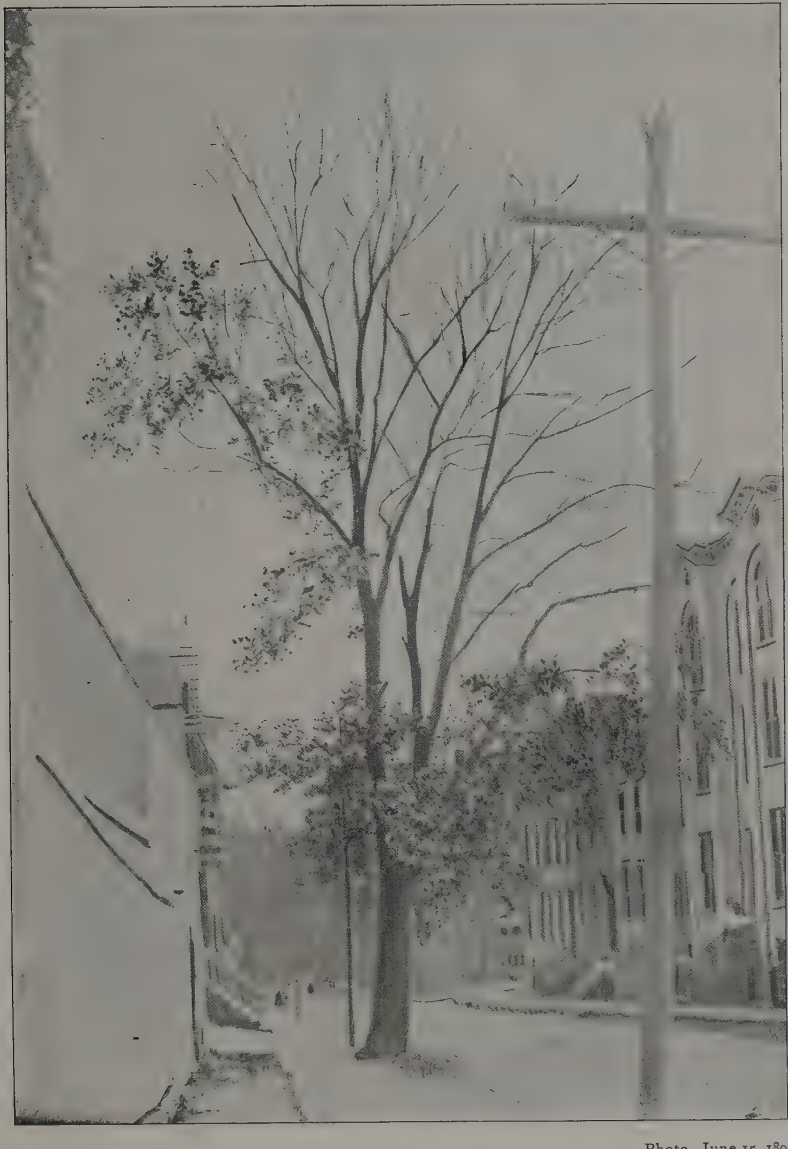
1 Work of European elm case bearer 2

PLATE 35

a 407

Elm leaf beetle, Galerucella luteola Müll.

Work on Elm street, Albany. Photographed June 15, 1898



Photo, June 15, 1898

Work of elm leaf beetle on Elm street, Albany

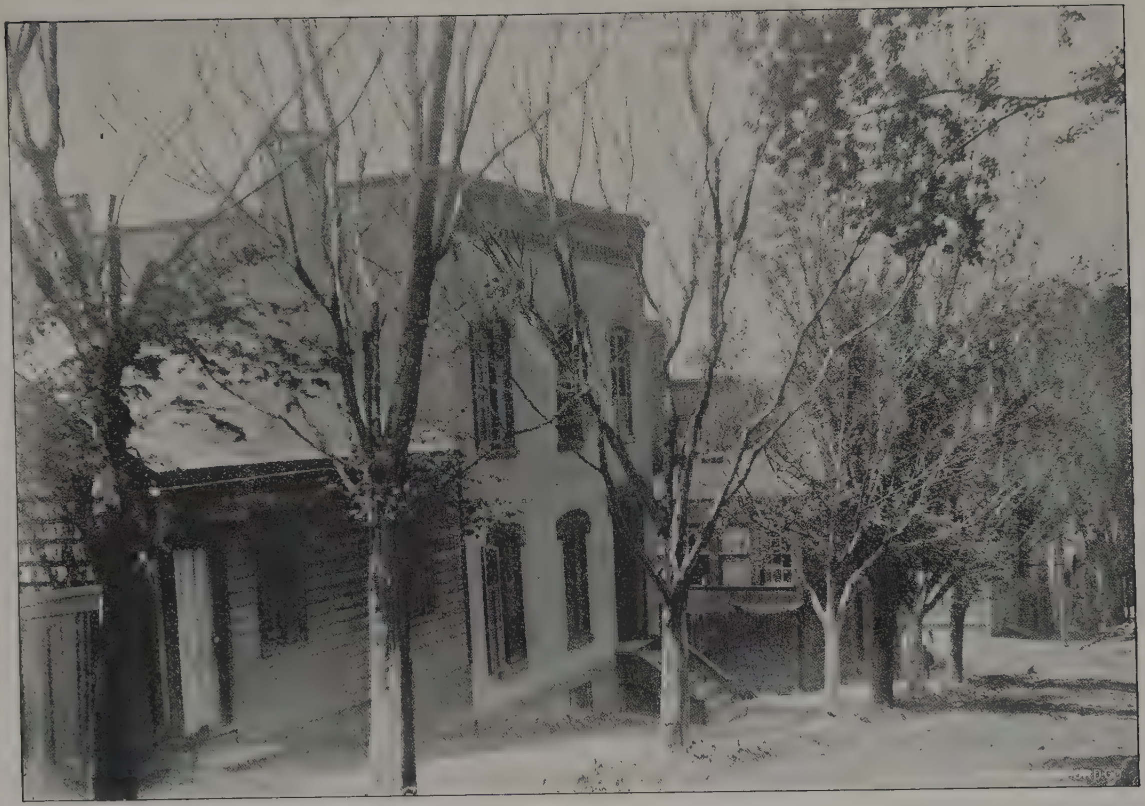
PLATE 36

a 409

Elm leaf beetle, Galerucella luteola Müll.

Work on Jacob street, Troy. Photographed June 15, 1898

Plate 36



Work of elm leaf beetle on Jacob street, Troy

Photo, June 15, 1898

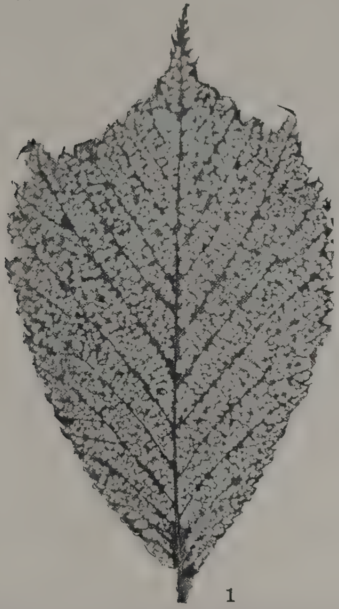
PLATE 37

a 411

Elm leaf beetle, Galerucella luteola Müll.

1 Leaf badly skeletonized by grubs

2 Leaves showing holes eaten by beetles



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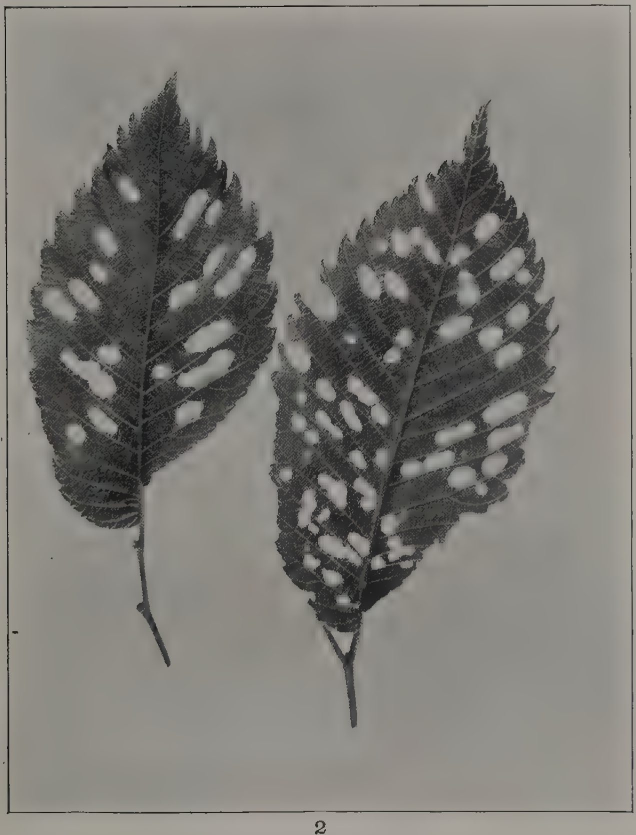


2

Elm leaf beetle work

PLATE 38

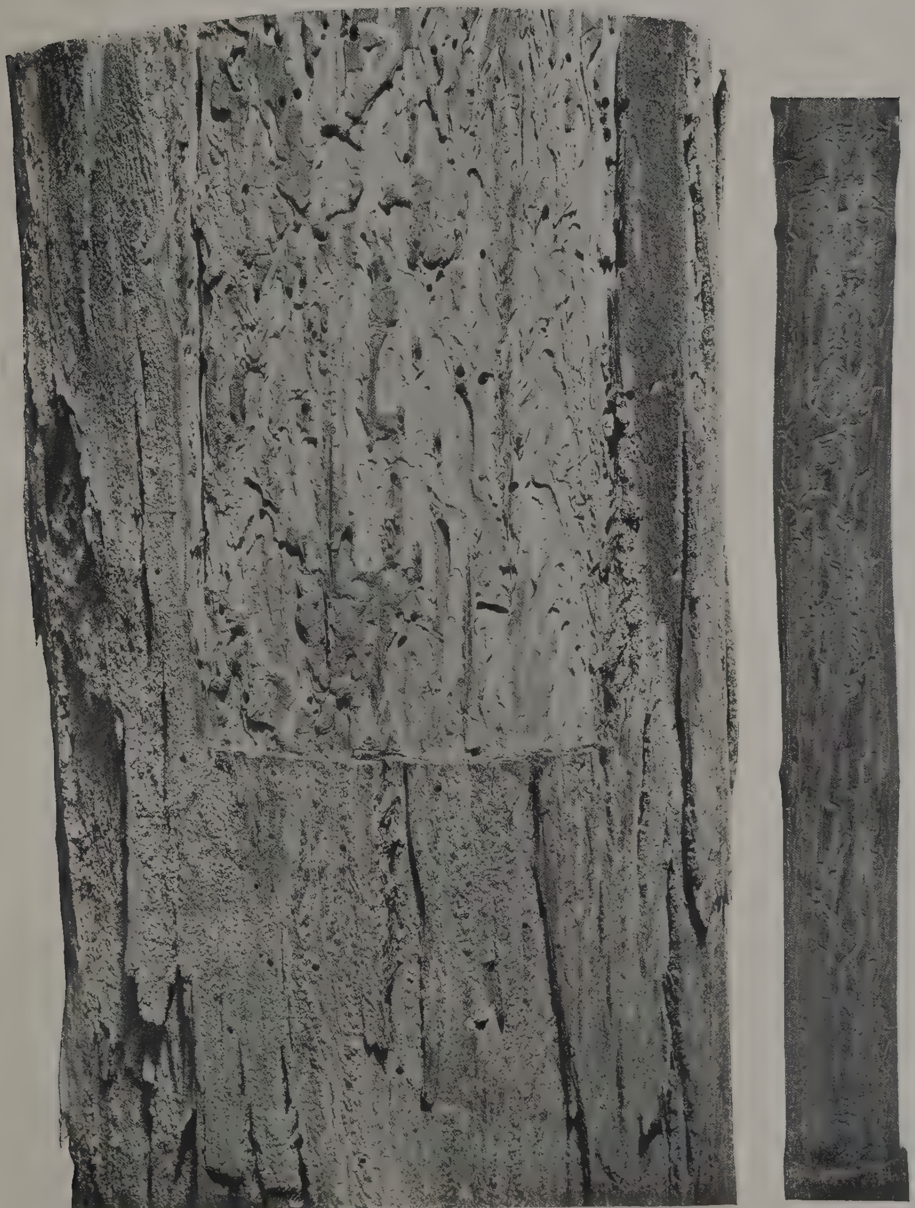
a 413

Rustic borer, Xylotrechus colonus Fabr.

1 Work in hickory trunk about 15 inches in diameter

Obrium rubrum Newm.

2 Work in ash



1 2

Work of wood borers

PLATE 39

a 415

Minute oak bark beetle, Pityopthorus minutissimus Zimm.

1 Work in red oak, upper part showing galleries, the lower exit holes

Eyed Elater, Alaus oculatus Linn.

2 Adult

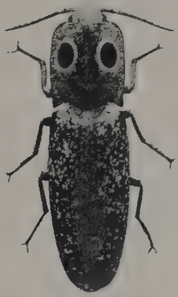
Large carpenter bee, Xylocopa virginica Drury

3 Work in siding, the ½ inch galleries being made in a ⅝ inch board. The enlargements in the gallery represent cells and the exit is seen at the upper part of the under portion.

Hickory bark borer, Scolytus quadrispinosus Say

4 Work in hickory, the upper portion showing the scored wood, the lower part the exit holes

1



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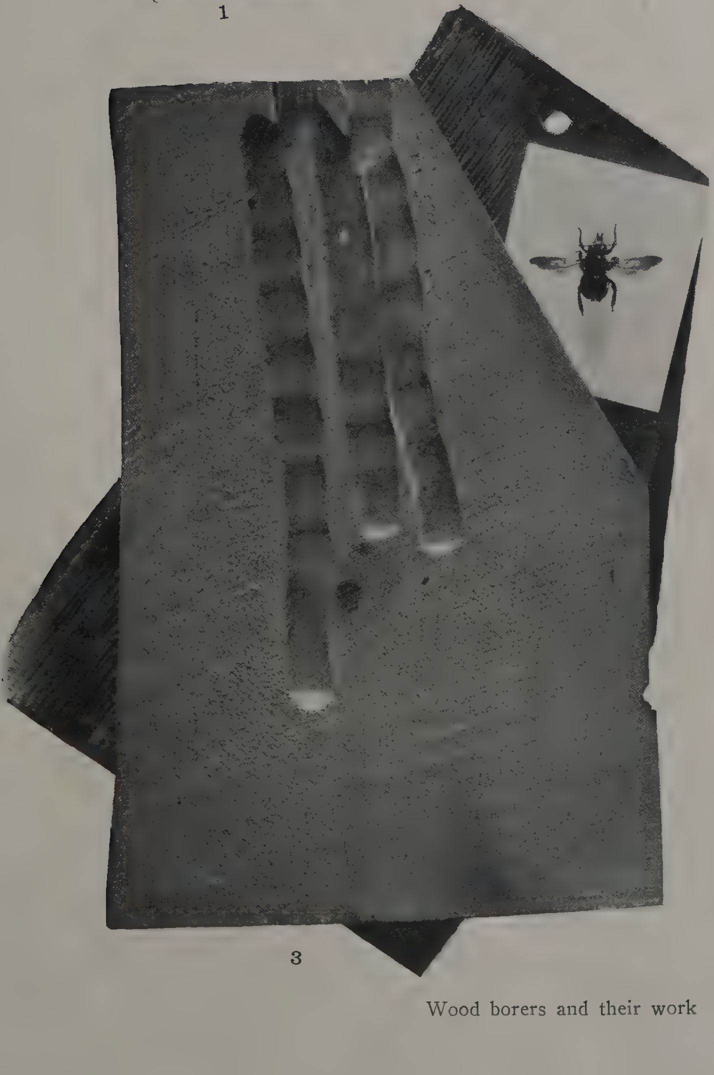


3

Wood borers and their work

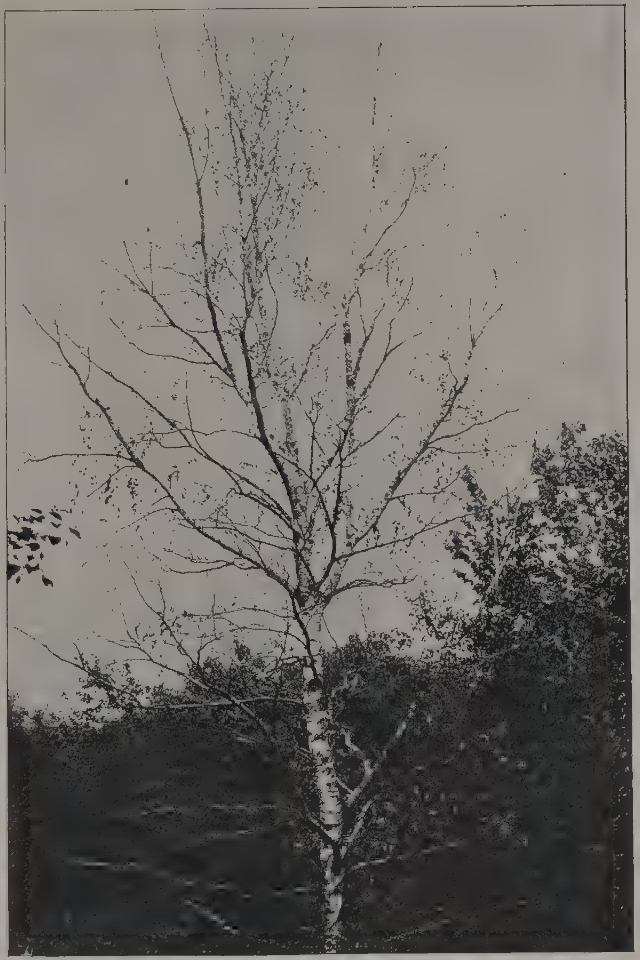
PLATE 40

a 417

Bronze birch borer, Agrilus anxius Gory

1 Dying tree

2 Section of limb showing anastomosing galleries in inner bark. Both from photos by M. F. Adams



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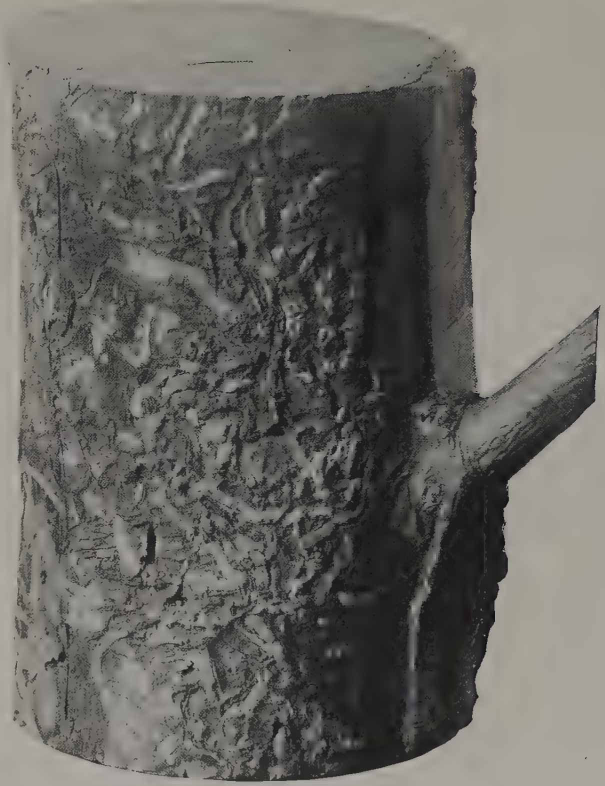


2

Work of bronze birch borer

PLATE 41

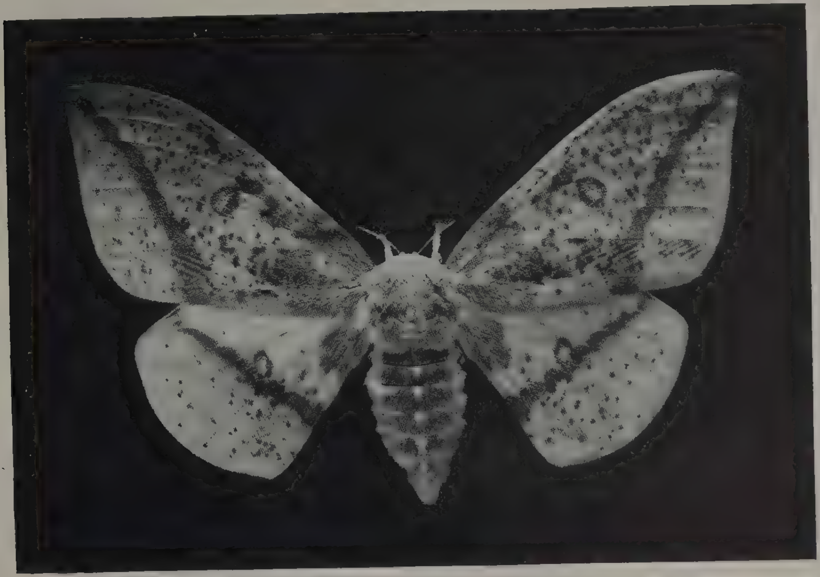
a 419

Imperial moth, Basilona imperialis Drury

1 Female

Luna moth, Tropaea luna Linn.

2 Male



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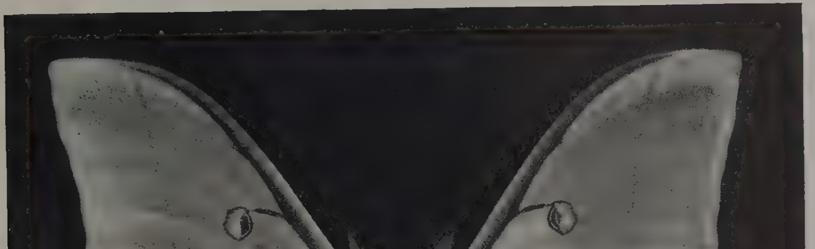


2

Parents of leaf feeders

PLATE 42

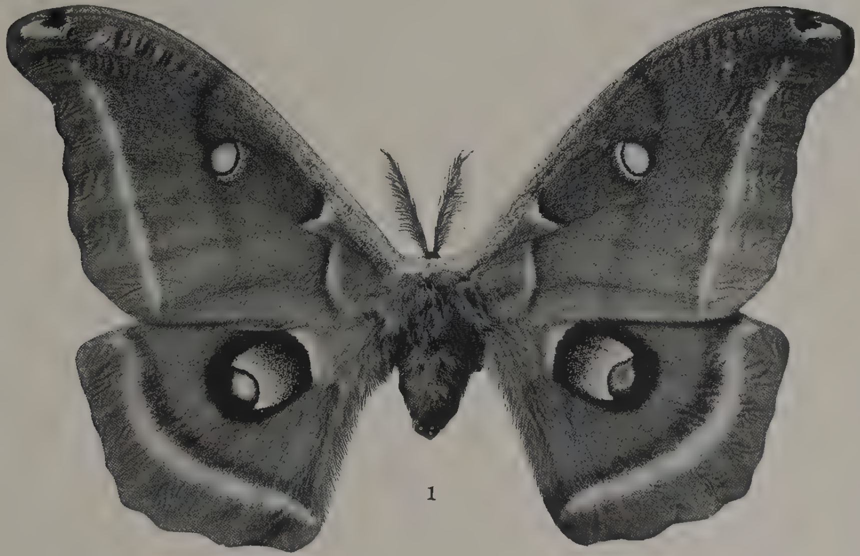
a 421

Polyphemus moth, Telea polyphemus Cramer

1 Male

Cecropia moth, Samia cecropia Linn.

2 Male



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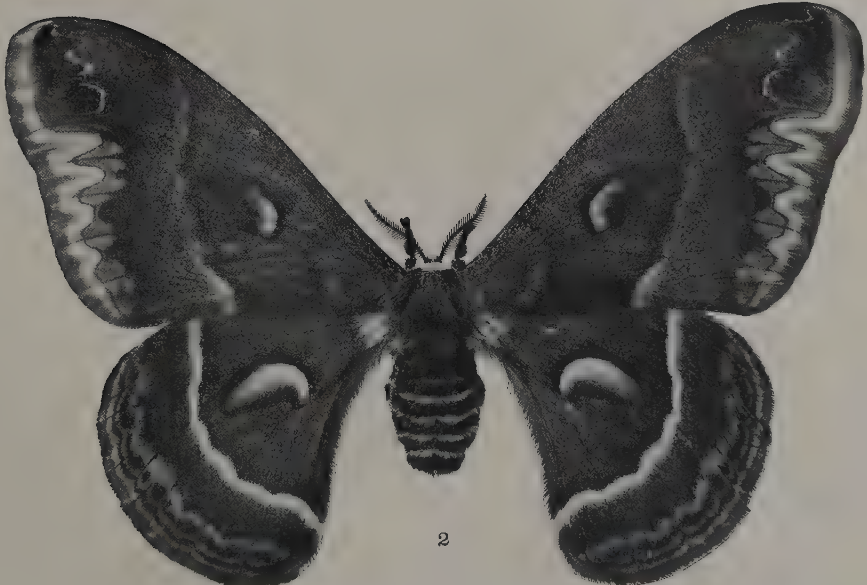


2

Parents of leaf feeders

PLATE 43

a 423

Io moth, Automeris io Fabr.

1 Female

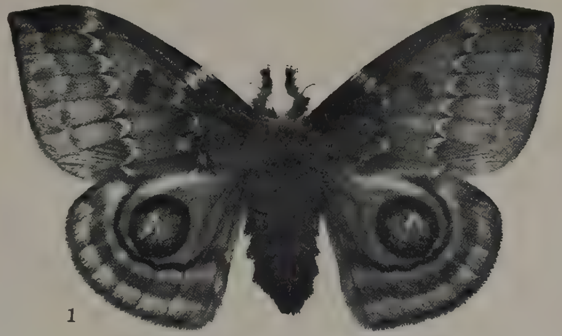
2 Male of same

Regal moth, Citheronia regalis Fabr.

3 Female

Promethea moth, Callosamia promethea Drury

4 Male



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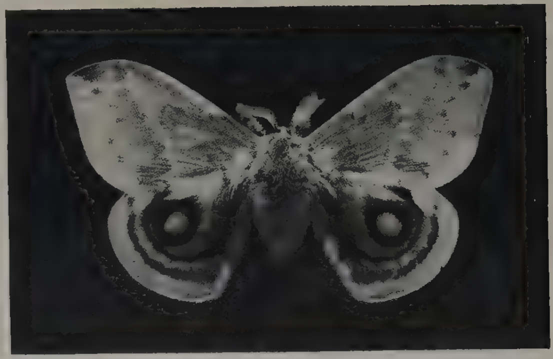

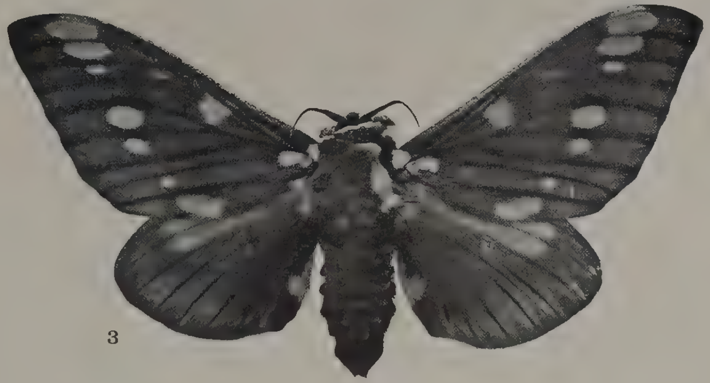

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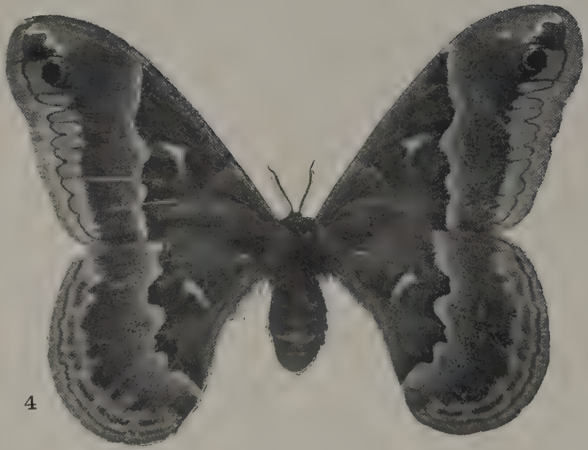


4

Parents of leaf feeders

PLATE 44

a 425

Cossus querciperda Fitch

1 Female, reproduced from a photograph of the type

Tomato worm, Phlegethontius celeus Hübn.

2 Larva bearing numerous parasitic cocoons

Hickory tussock moth, Halisidota caryae Harr.

3 Male

Pale tussock moth, Halisidota tessellaris Abb. & Sm.

4 Female

Buck or maia moth, Hemileuca maia Drury

5 Male

Xylina antennata Walk.

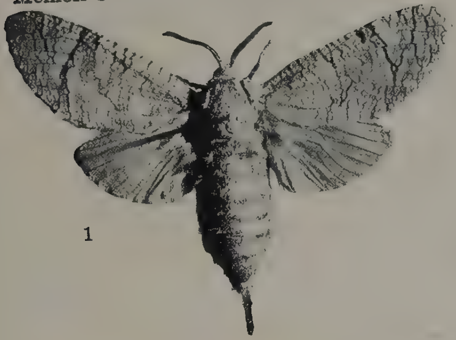
6 Female

Harpyia cinerea Walk.

7 Male

Black walnut caterpillar, Datana integerrima Gr. & Rob.

8 Female moth



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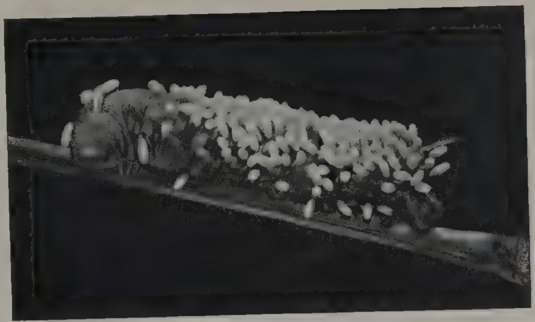

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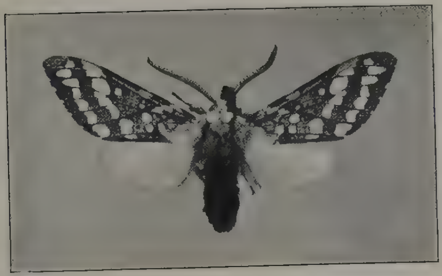

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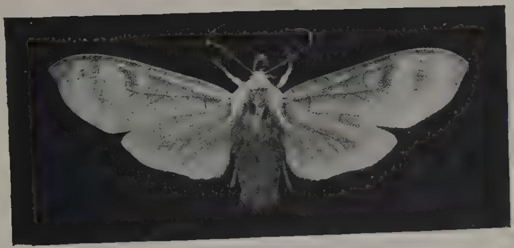

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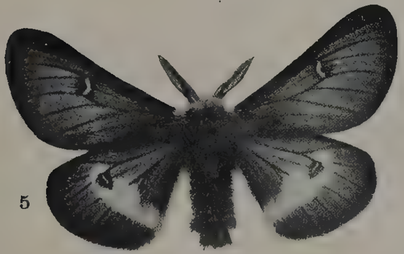

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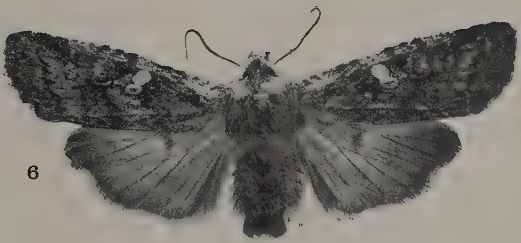

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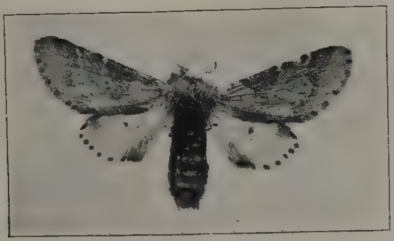

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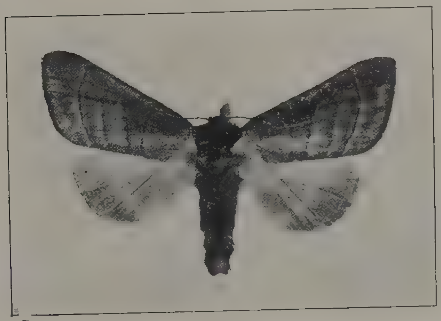


8

American Lepidoptera

PLATE 45

a 427

1 Work of sawfly on willow leaves

Locust leaf miner, Odontota dorsalis Thunb.

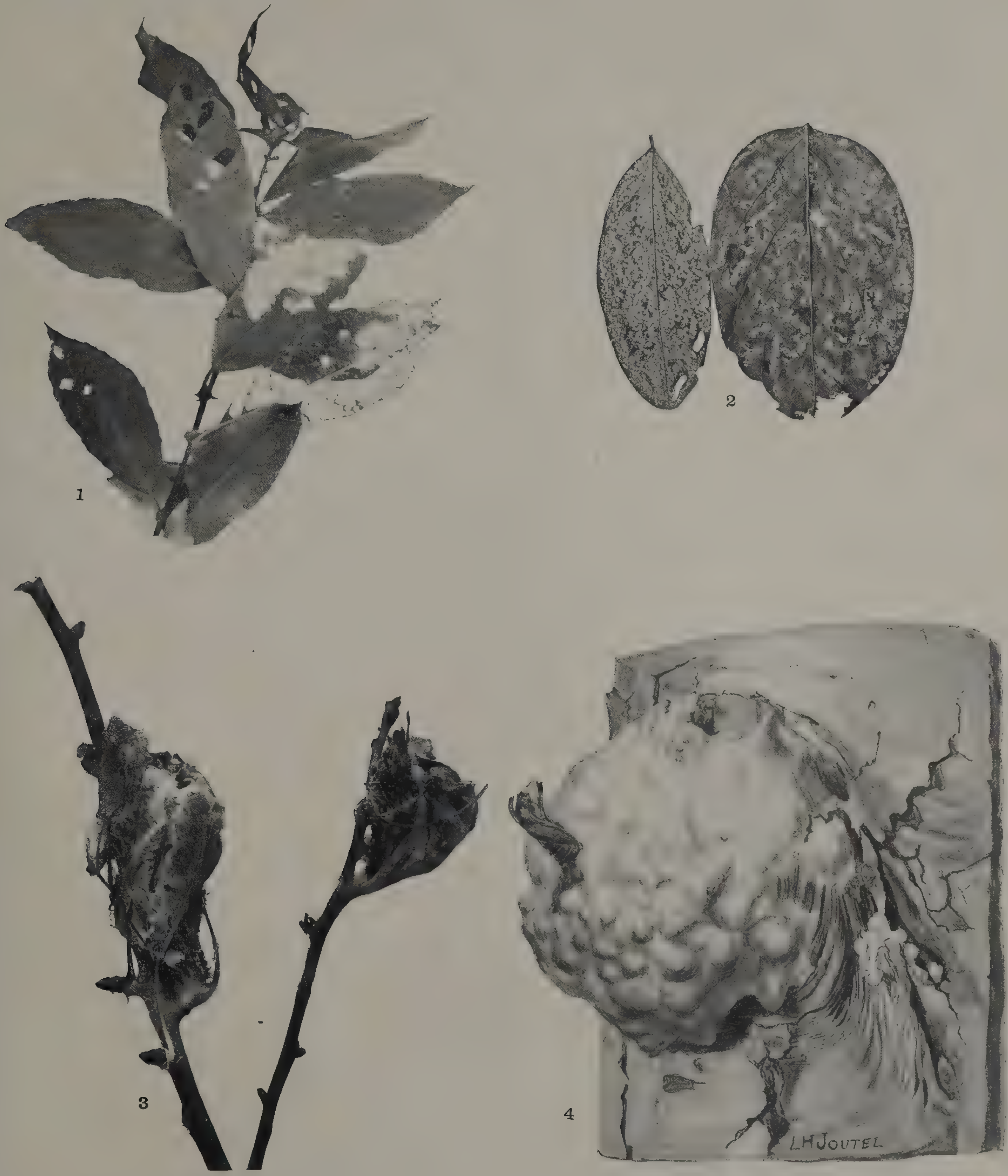
2 Work of beetles

Brown tail moth, Euproctis chrysorrhoea Linn.

3 Two characteristic nests

Pitch-mass borer, Parharmonia pini Kell.

4 Pitch mass with empty cocoon protruding



Brown tail moth nests and other insect work

PLATE 46

a 429

Dog day cicada or harvest fly, Tibicen tibicen Linn.

1 Adult

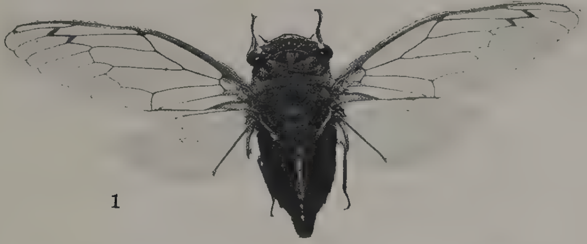
Periodical cicada, Tibicen septendecim Linn.

2 Adult

Alder blight aphid, Pemphigus tessellata Fitch

3 Portion of alder twig badly infested

4 Twig infested with young



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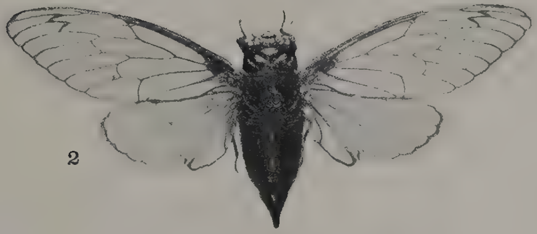

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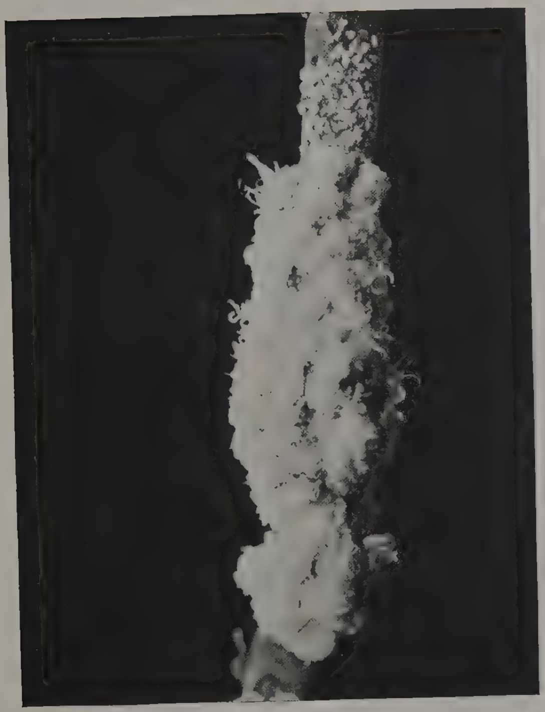


3

4

Cicadas and alder aphids

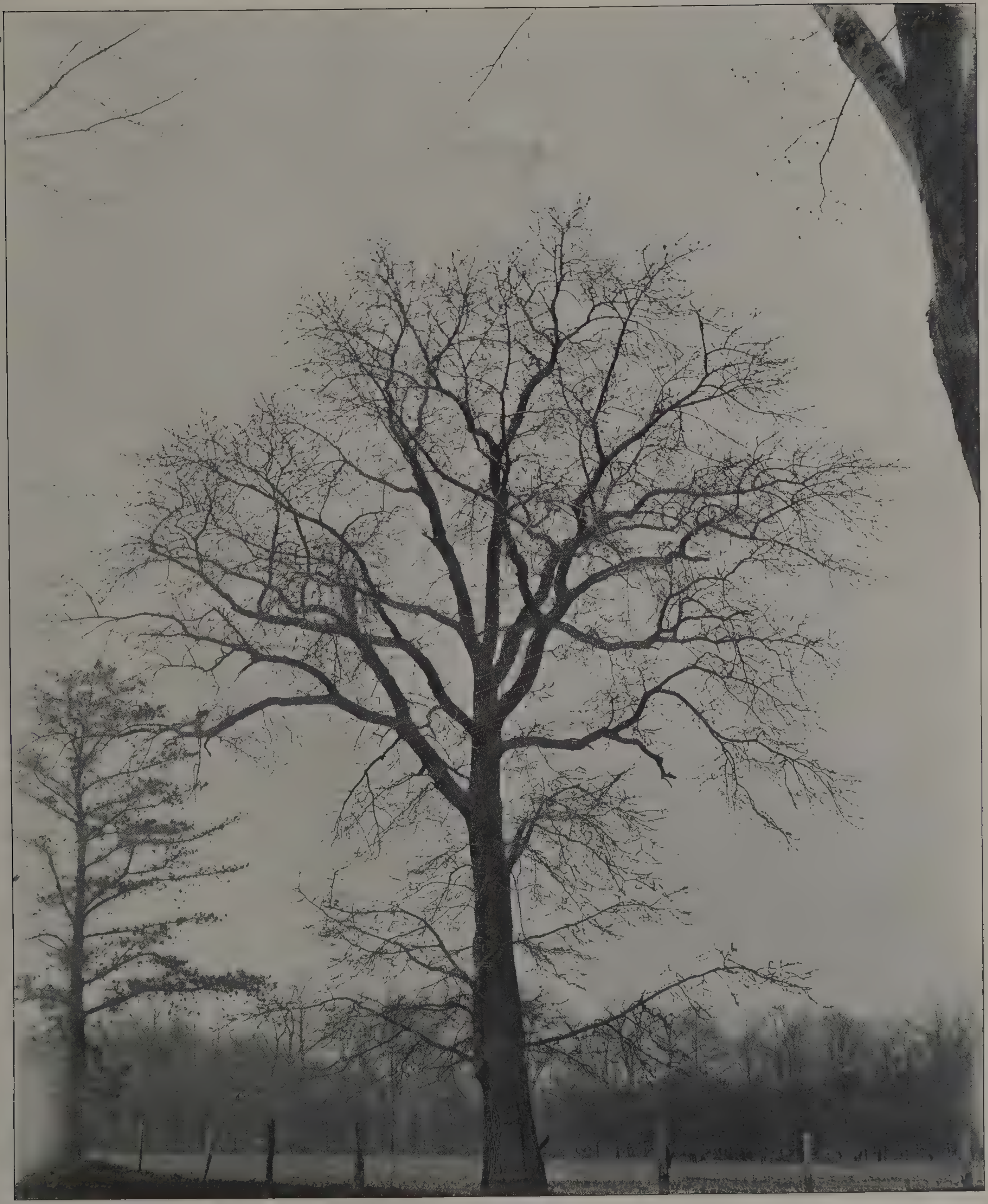
PLATE 47

a 431

Gouty oak gall, Andricus punctatus Bass.

A red oak at Loudonville badly infested

a 432



Loudonville, Photo, April 1902

Red oak bearing numerous gouty oak galls

PLATE 48

a 433

Oak fig gall, Biorhiza forticornis Walsh

1 Infested leaves and twig

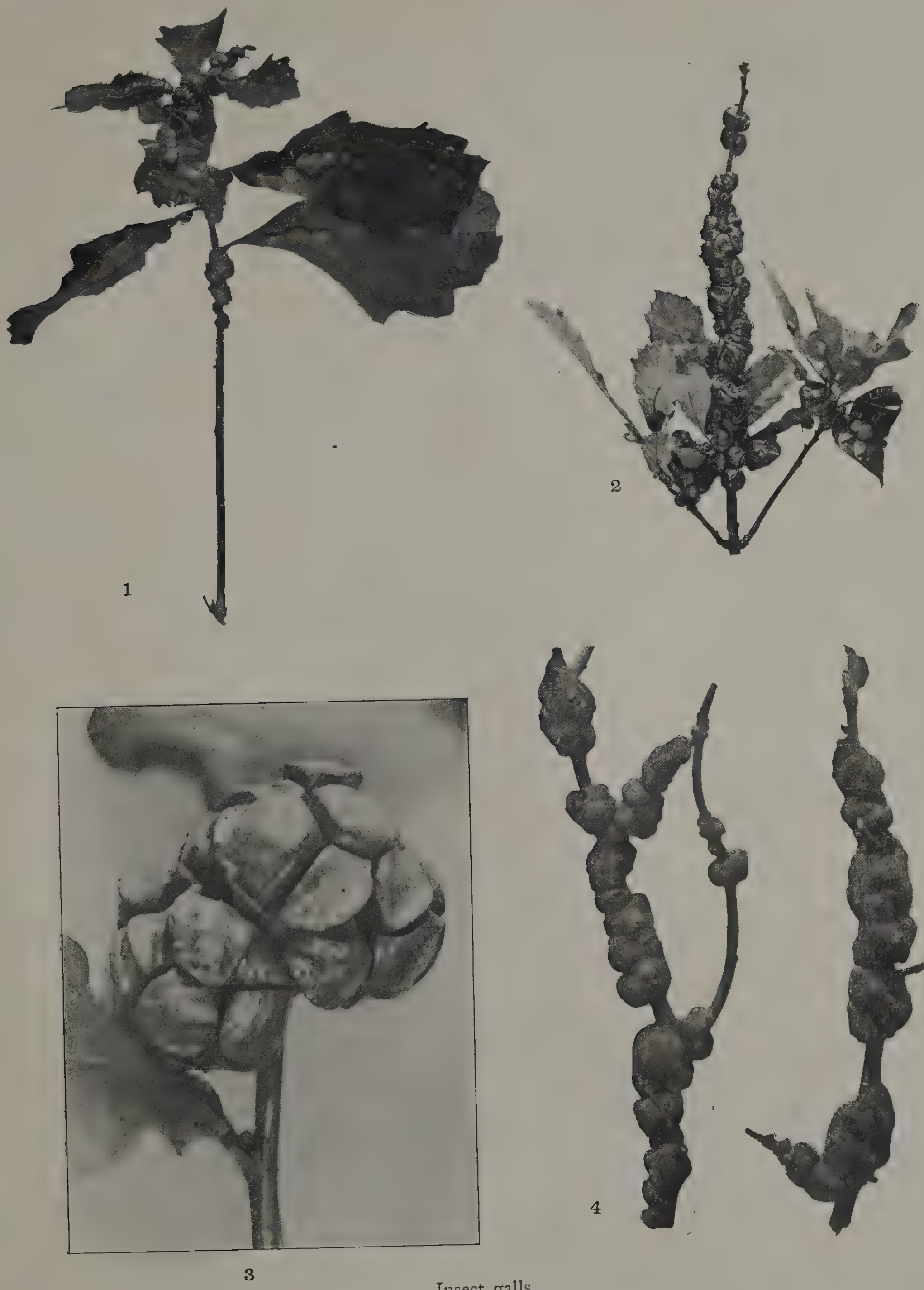
2 Same more advanced and largely on twigs

Pine cone oak gall, Cynips strobilana O. S.

3 A gall at the end of a twig

Gouty oak galls, Andricus punctatus Bass.

4 Badly infested twigs



Insect galls

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